HE ENGINEERING CONSTRUCTION WEEKLY

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April 7, 1938

Paducah, Ky., during the Ohio River flood of 1937

BRIDGES · IRRIGATION · FLOOD CONTROL · FOUNDATIONS · DAMS ·

GHWAYS · WATERWORKS · STREETS · SEWERS ·

Underground and Under-Water
BYERS WROUGHT IRON
Conduit

● Cable conduit exposed to corrosion under-water, underground or in the atmosphere should be of Byers Wrought Iron Pipe.

Not only will Byers Wrought Iron Pipe conduit last longer under corrosive conditions, but it also possesses the strength and ductility required to withstand severe physical stresses which result in mechanical failure.

Wrought iron pipe, either black or galvanized, to be used as conduit is furnished plugged and reamed insuring smooth surfaces that prevent abrasion of cable covering. Also, when specified, the wrought iron pipe can be so threaded that the pipe ends will butt together perfectly in the special coupling.

These are some of the reasons why leading engineers are specifying Byers Wrought Iron Pipe for conduits. Several such installations have been made recently by the Signal Department of the Pennsylvania Railroad. Illustrated is a conduit of Byers Wrought Iron which crosses Christiana Creek near Newark, Delaware.

If you have a current project involving underground or river-crossing service of any kind, let us prepare for you a special engineering report on the subject. Just tell us the location. Address your request to our nearest Division Office or write our Engineering Service Department in Pittsburgh. A. M. Byers Co. Est. 1864. Pittsburgh, Boston, New York, Philadelphia, Washington, Chicago, St. Louis, Houston, Seattle, San Francisco.

BYERS GENUINE WROUGHT IRON
TUBULAR AND FLAT ROLLED PRODUCTS
SPECIFY BYERS GENUINE WROUGHT IRON PIPE FOR CORROSIVE SERVICES AND BYERS STEEL PIPE FOR YOUR OTHER REQUIREMENTS

THE WEEK'S EVENTS

Cement for Federal Projects To Be Centrally Purchased

Open bids to be asked f.o.b. mill on full requirements of federally financed projects for four months period

Purchase of all cement used by federal departments and agencies has been centralized, effective April 1, Secretary of the Treasury Morgenthau has announced. Cement manufacturers have been asked to make bids to furnish indefinite amounts of cement over a four months period at prices f.o.b. the point of manufacture. The bidders will be required to furnish cement at no higher price to any person or agency purchasing cement for use on any project wholly or partly financed by the federal government.

For the purpose of taking bids on cement, the country has been divided into 63 zones and sub-zones. Bidders in each zone will submit an offer to furnish cement at a stated price and state the maximum amount per month and over a four months period which they are prepared to supply. With the lowest acceptable bidder in each zone or sub-zone the government will execute a contract binding the bidder to furnish the cement on request. As cement is needed for any particular project, purchase will be made from the contract-holding mill so situated that the price of the cement plus transportation will be the lowest.

The first bids under the new plan will be opened April 15 covering requirements for the four months, May through August. The government estimates that about 3,000,000 barrels of cement will be used in this period.

Statement on collusion

Each bidder is required to submit with his bid a statement that the prices quoted are not the result of agreement with any other bidder. The wage, hour, and other requirements of the Walsh-Healey government contracts act will apply to all purchases.

Bidders are requested to offer discounts for payment within 10, 20 and 30 days and for purchases of "large quantities in excess of 200 barrels."

Separate prices are asked on portland, high-early-strength, moderate heat, and sulphate-resisting cements. Prices for various methods of delivery are asked. These include bulk cement in carloads and sacked cement, both cloth and paper, in either less than carload or carload lots. Less than carload lots are subdivided into orders of less than 100 or more than 100 barrels.

Successful bidders will be required to provide a performance bond of not more than $10,000 guaranteeing delivery of any amount requested up to the maximum.

Inspection of cement may be waived by the ordering office, but where inspection is waived, the contractor must be prepared to furnish a manufacturer's certificate of compliance with specifications.

In cases where inspection is waived, portland cement and high-early-strength cement must be delivered to the carrier within 24 hours from the receipt of the purchase order. Medium-heat and sulphate resisting cement must be furnished within 15 days.

Effect of Order

The new order attempts to set up a new delivery and price plan in place of the delivered-price plan long established in the cement industry. The latter, often called the "multiple-basing-point" system, has been under question on the part of the Federal Trade Commission for a number of years, and a formal complaint proceeding against cement manufacturers is at present in process of trial hearings at Washington. It is feared that the new order, coming during the pendency of this trial, may operate to prejudice the FTC.

Cement manufacturers generally decline to comment on the order, but it is pointed out that the indefinite character of the provisions makes it practically unworkable and such as to involve inordinately high costs at best.

At present only a minority of mills produce other than standard or "gray" cement, and very few are equipped to make sulphate-resisting cement.

Wide World Photo

TORNADO STRIKES AGAIN IN MIDWEST

THIRTY-SIX people were killed when new tornadoes moved through four Midwest states on March 31, repeating the storms of the preceding week. In Columbus, Kan., where the grade school above was torn open, 50 buildings were wrecked and six persons killed.

Repairs Completed On Auditorium

Roof of Atlanta structure repaired after collapse last summer during a rain storm

Reconstruction of the Atlanta auditorium, of which a portion of the roof collapsed last August (ENR, Sept. 2, 1937, p. 375), has been completed, and the auditorium was dedicated March 29.

The auditorium was originally built in 1908 and was modernized as a WPA project. The reconstruction, which involved erection of an entire new roof, had been completed and the building was about to be dedicated when, on Aug. 22, a portion of the roof failed under a heavy water load during a rain storm.

Repair of the roof, carried out as a new WPA project, followed the recommendations of a special advisory board employed by the city to study the failure. In accordance with the board's advice, the open web joists used in the collapsed portion of the roof were replaced with rolled structural sections and the roof was reframed with a pitch of ¼ inch to the foot.

As a precautionary measure, the undamaged portion of the roof, which was also supported by open web joists, was reinforced. Underneath the open web joists, which span from truss to truss, continuous channel sections were placed welded to the joists at the third points of the span. These channels were supported by light wide-flanged I-beams paralleling the main trusses and hung from them by bar hangers.

The suspended metal lath and plaster ceiling was provided with additional bracing to compensate for the undetermined horizontal shock to which it was subjected at the time of the roof failure.

Design changes

A board of inquiry was employed by the city to check the design and structural features of the building. The board determined that the structure had been built by the WPA entirely in accordance with the plans prepared by the project architects, Dillon & Lewis, of Atlanta. The board recommended a number of changes, which were made as part of the repair project.

Carrying out the recommendations of this board, the columns supporting the gallery girders were re-located. In addition, the organ loft was strengthened to carry an organ heavier than that originally planned for. This was done by the addition of more hangers and of two extra columns.

Wide World Photo

OVERSEAS ROAD OPENED

OVERSEAS road and the toll bridge system connecting the island of Key West with the mainland went into service March 29. The highway, built with a PWA loan of $3,600,000, utilizes the roadbed and bridges of the railroad which connected Key West with the tip of the Florida peninsular before the hurricane of 1935.

Eleven bridges were reconstructed by the Overseas Road and Toll Bridge District, and the highway was hard surfaced for its full length, with a 20-ft. roadway between curbs over all bridges.

Tolls have been set at $1 per car and driver, with 25 cents extra for each additional passenger.

ENGINEERING CONSTRUCTION CONTRACTS REPORTED BY ENGINEERING NEWS-RECORD, IN MARCH, 1938

Engineering News Record *reports projects of the following minimum costs: Water-works, excavation, drainage and irrigation,* $15,000; *other public works,* $25,000; *industrial buildings,* $40,000; *other buildings,* $150,000.

Five Weeks — Thousands of Dollars (000 Omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States March 1938	United States Three Months 1938	United States Three Months 1937	Canada
Public Works										
Waterworks	629	2,431	589	1,860	1,058	1,454	**8,021**	12,840	27,347	1,208
Sewerage	587	3,592	458	2,900	944	334	**8,815**	28,669	23,991	.....
Bridges, public	395	2,779	1,031	653	2,962	1,333	**9,153**	18,300	26,474	289*
Earthwork and waterways	1,158	1,656	951	3,312	11,585	3,760	**22,422**	74,989	22,170	647
Streets and roads	4,048	7,047	7,869	4,804	7,439	6,489	**37,696**	93,949	59,774	2,134
Buildings, public	1,073	21,967	5,208	4,326	5,512	3,282	**41,368**	113,094	73,636	1,232
Unclassified, public	291	3,112	207	995	1,032	1,046	**6,683**	25,751	28,846	60
Total public	**8,181**	**42,584**	**16,313**	**18,850**	**30,532**	**17,698**	**134,158**	**367,592**	**262,238**	**5,560**
Federal government (included in above classifications)	365	5,050	1,996	1,661	8,081	4,661	**21,814**	80,017	44,739	.....
Private										
Bridges, private	13	272	.....	.....	.....	25	**310**	2,486	2,144	.....
Buildings, industrial	781	4,128	1,051	5,950	1,370	1,774	**15,054**	58,166	106,912	850
Buildings, commercial	2,350	78,874	1,573	3,793	2,457	3,325	**92,372**	199,331	75,863	240
Unclassified, private	250	5,834	6,220	402	1,907	2,611	**17,224**	31,210	71,905	742
Total private	**3,394**	**89,108**	**8,844**	**10,145**	**5,734**	**7,735**	**124,960**	**291,193**	**256,824**	**1,792**
Total Engineering Construction										
March, 1938 (5 weeks)	**11,575**	**131,692**	**25,157**	**28,995**	**36,266**	**25,433**	**259,118**	.....	.....	7,352
February, 1938 (4 weeks)	5,472	95,483*	8,618	22,614	27,094	50,200	209,481*	.....	.....	2,760
March, 1937 (4 weeks)	9,975	66,735	6,895	30,257	21,351	21,575	**156,788**	.....	.....	8,754
Three Months, 1938	23,235	297,778	64,742	77,340	102,513	93,177	.....	658,785	.....	12,912
Three Months, 1937	23,100	238,826	46,364	81,609	74,353	54,810	.....	.....	519,062	18,123

* Revised

THE CURRENT TREND

This week's news of contract volume and construction cost factors

THIS WEEK'S FIGURES

(Thousands of Dollars)

CONTRACTS

	Week Ending Apr. 8 1937	Mar. 31 1938	Apr. 7 1938
Federal	$3,247	$2,822	$1,995
State & Municipal	19,718	22,524	25,460
Total public	$22,965	$25,346	$27,455
Total private	27,813	11,763	12,096
TOTALS	$50,778	$37,109	$39,551

Cumulative
1938 (14 weeks) $698,336
1937 (14 weeks) $604,518

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works $25,000; industrial buildings, $40,000; other buildings, $150,000.

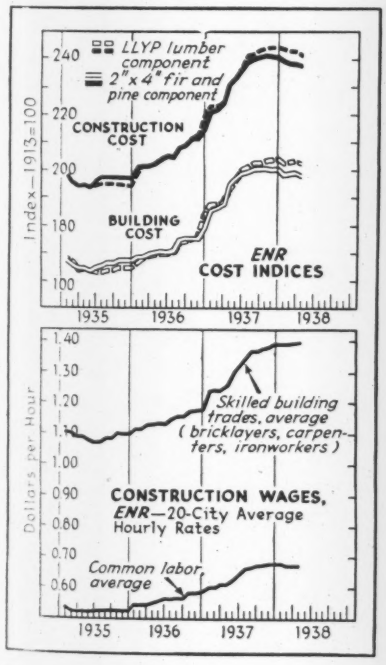
NEW PRODUCTIVE CAPITAL

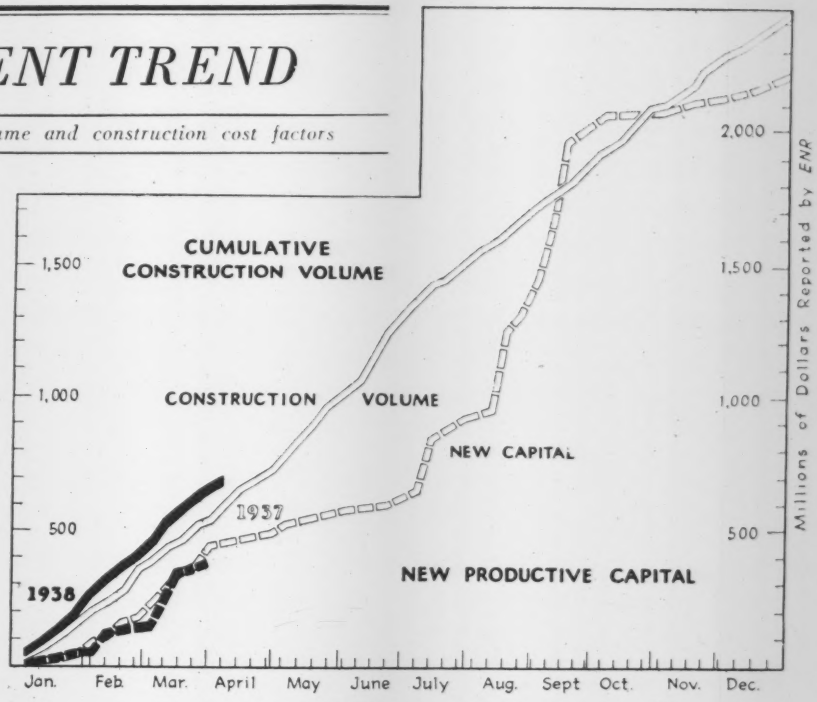
	1937 14 Wk.	Cumulative 1938 14 Wk.
NON-FEDERAL	$454,603	$386,537
State & mun. bonds	165,497	212,898‡
Corporate securities	213,405	96,800
PWA loans, grants	46,562	−2,417‡
RFC loans	29,139	62,420
U.S.H.A. loans	.....	16,836
FEDERAL	.....	62,500
TOTAL CAPITAL	$454,603	$449,037

‡ Represents transfer from federal to private investment financing through sale by RFC of PWA bonds.

ENR INDEX NUMBERS

CONSTRUCTION COST Base = 100	1913	1926	VOLUME	1913	1926
Apr., 1938	237.95	114.38	Mar., 1938	188	82
Mar., 1938	238.79	114.79	Feb. 1938	189	83
Apr., 1937	231.35	111.16	Mar., 1937	146	64
1937 (Av.)	234.71	112.66	1937 (Av.)	172	75
1936 (Av.)	206.42	99.15	1936 (Av.)	185	81
1935 (Av.)	196.44	94.43	1935 (Av.)	134	59





THE MONTH'S SCOREBOARD

CONSTRUCTION VOLUME & NEW PRODUCTIVE CAPITAL

(,000 omitted)	March 1937	March 1938*	% Change	Three months 1937	Three months 1938†	% Change
Total Construction (ENR)	$156,788	$259,118	+32	$519,062	$658,785	+17
Private	81,827	124,960	+22	256,824	291,193	+ 5
Public	74,961	134,158	+43	262,238	367,592	+29
Federal	18,023	21,814	− 3	44,739	80,017	+65
Total New Productive Capital (ENR)	$194,040	$241,197	−1	$377,494	$371,053	−8
Private Investment	143,296	164,050	−8	330,925	294,294	−18
Federal (non-fed. wk.)	50,744	77,147	+22	46,569	76,759	+52

* 5-week month. † 13 weeks.

CONSTRUCTION COSTS . . . WAGE RATES . . . PRICES

	April 1937	April 1938	% Change	Change Mar. to Apr. 1937 Mar.	1937 Apr.	%	1938 Mar.	1938 Apr.	%
ENR Construction Cost Index, 1913 = 100	231.35	237.95	+3.0	224.75	231.35	+3.0	238.79	237.95	−0.3
ENR Building Cost Index, 1913 = 100	194.95	198.21	+1.6	187.65	194.95	+4.0	199.29	198.21	−0.5

ENR 20-CITIES AVERAGE

Common Labor	$0.612	$0.677	+10.0	$0.612	$0.612	0	$0.675	$0.677	+0.3
Skilled Labor (Aver. 3 Trades)	1.258	1.399	+11.0	1.246	1.258	+1.0	1.396	1.399	+0.2
Bricklayers	1.332	1.486	+11.0	1.319	1.332	+1.0	1.480	1.486	+0.4
Struct. Ironworkers	1.320	1.448	+10.0	1.308	1.320	+1.0	1.448	1.448	0
Carpenters	1.123	1.263	+12.0	1.111	1.123	+1.0	1.263	1.263	0
Cement, per bbl	$2.53	$2.55	+0.8	$2.54	$2.53	−0.4	$2.55	$2.55	0
Reinforcing Steel, new billet	2.88	2.88	0	2.78	2.88	+3.6	2.86	2.88	+0.7
Struct. Steel, Pittsburgh	2.25	2.25	0	2.05	2.25	+9.8	2.25	2.25	0
Sand, per ton	1.19	1.29	+8.3	1.17	1.19	+1.7	1.27	1.29	+1.6
Lumber, 2x4 Fir, per M ft	39.50	32.90	−16.7	36.88	39.50	+7.1	34.15	32.90	−3.6
Lumber, 2x4 Pine, per M ft	34.28	28.06	−18.2	33.94	34.28	+1.1	29.03	28.06	−3.3
Brick, common, per M	14.05	14.20	+1.1	13.88	14.05	+1.2	14.24	14.20	−0.3
Ready-mixed Concrete, c. y.	7.22	7.34	+1.7	7.22	7.22	0	7.39	7.34	−0.7
Struct. Clay Tile, 3x12x12	73.18	73.91	+1.0	74.08	73.18	−1.2	74.55	73.91	−0.9
Paving Asphalt, cars, ton	17.27	16.40	−5.0	17.16	17.27	+0.6	16.40	16.40	0

MATERIAL SHIPMENTS . . . BUILDING PERMITS

	March 1937	March 1938	% Change	Feb. 1938	% Change Feb.–Mar.
Lumber (% 1929 wk. av.) N.L.M.A.	76	57	−25.0	52	+9.6
Steel (% operating capacity) A.I.S.I.	88.5	32.1	−63.7	30.4	+5.6

	February 1937	February 1938	% Change	Two Months 1937	Two Months 1938	% Change
Fabricated Struct. Steel, (A.I.S.C.) tons	102,196	86,421	−15.5	202,130	164,169	−18.7
Cement, Thous. bbl. (U.S.B. of M.)	5,163	4,575	−11.5	9,852	8,965	−10.0
Building Permits, Dun and Bradstreet, (,000 omitted)	$85,829	$54,065	−37.0	$154,342	$200,931	+30.2

RENT INDEX . . . EMPLOYMENT

	February 1937	February 1938	% Change	Jan. 1938	% Change Jan.–Feb.
Rent (housing) Index, N.I.C.B.	82.8	87.8	+6.0	88.2	−0.5
Trade Unions, % employed, A.F.L.	86.0	79.0	−8.0	80.0	−1.0
Building Trades, % employed, A.F.L.	69.0	57.0	−17.0	60.0	−5.0

Unappropriated Waters Claimed For United States

Attorney-General seeks to intervene in adjudication of North Platte River rights by the Supreme Court

Claiming that the United States owns all unappropriated water in the North Platte River free of control by the states through which it flows, Attorney-General Cummings on April 1 requested permission of the U. S. Supreme Court to intervene in a suit brought by the state of Nebraska against Wyoming and Colorado for the apportionment of the waters of that stream.

If the federal government is permitted to intervene, it is anticipated that all of the arid states will eventually become involved in the case, since the legal basis upon which the Attorney-General bases his claim is equally applicable to other streams in other states.

Briefly, Cummings' argument is that cessions of territory to the United States by France, Spain, Mexico and Texas vested in the federal government the use of all waters except those privately owned at the time of the transfer. Congress, he states, has never relinquished these water rights and therefore they still remain in the federal government. The fact that private appropriators have consistently sought and been granted water rights under the laws of the various states does not affect federal ownership of water still unappropriated, he claims, although such grants have materially diminished the amount of such water remaining. In making these grants the states have been disposing of federal property with the acquiescence of Congress, and the resulting private rights have derived, not from the state making the grant, but from the United States. Federal compliance with state laws in carrying out reclamation projects has been a matter of comity and not of necessity.

The wide-spread effect that would result if the contentions of the Attorney-General are upheld by the court are indicated by the following quotation from the brief:

"These issues are of great consequence to the United States, both with respect to its reclamation projects in the North Platte River basin and with respect to similar federal reclamation projects throughout the arid sections of the country. It is important to the United States that it be allowed to represent its own interests in litigation . . . It is more important whether the United States, after it has substantially complied with state laws in initiating and perfecting an appropriation of waters, is subject to the sovereign supervision and control of the states in its use and distribution of those waters. . . . The laws of both Wyoming and Nebraska provide that the use of water for irrigation is superior to its use for hydro-electric development, and that water rights acquired for the latter purpose may, on payment of just compensation, be taken by anyone for irrigation. While no power to condemn for irrigation waters which the United States uses for hydroelectric development has been asserted, such power would exist if the United States is subject to state control in its uses of water. Similarly, the United States would be subject to state power to fix rates for electricity and for the transportation of waters."

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H. W. Alrich Dies

Herbert W. Alrich, engineer of the Consolidated Edison Co., New York, died of a heart attack on March 25 while en route to New York from a Western trip. He had been engaged in structural and construction work with the Consolidated Gas Co. and its successor, the Consolidated Edison Co., for many years and did particularly notable work in connection with the design and construction of gas holders and the problems of purging gas apparatus, mains and holders.

Born in Wilmington, Del., in 1872, Mr. Alrich was engaged for some years in the service of William Sellers & Co., Philadelphia, in the design of heavy machinery and machine tools. He joined the staff of the New Amsterdam Gas Co. in New York City in 1901, and remained with the company and its affiliates in the Consolidated Gas Co. during the remainder of his career. His first work was in connection with the enlargement of the Ravenswood gas works, Long Island City. Gas-holder problems soon engaged his attention, and in 1910 he was awarded the Beal medal of the American Gas Institute, highest honor awarded in the gas industry, for a paper, "Brick, Concrete and Steel Holder Tanks." In a subsequent paper, 1913, he presented a study of the operation and proper design of cups and seals for water-sealed holders which quickly became a standard treatise on the subject and found extensive circulation in this country and abroad. He contributed many other papers on this and other gas-plant subjects to American literature.

In 1913 Mr. Alrich was appointed assistant engineer of construction of the Consolidated Gas Co. In recent years he was active in the company's inventory and valuation work, and took an important part in rate proceedings. He repeatedly went abroad for his company to investigate European holder practice, and made special studies of the holder explosion at Pittsburgh in 1927 and that at Neunkirchen, Germany, in 1933. He was frequently consulted by operating engineers of many different countries on holder matters.

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Super Highways Are Urged For New York State

Calling attention to the fact that New York State has fallen far behind other states in the matter of good highways, and does not meet present-day requirements, state superintendent of public works Greene recommends construction within the next 12 years of more than 900 miles of superhighways at a cost of about $300,000 per mile. The recommendation is made in an annual report submitted to the 1938 legislature.

The superintendent recommends that a construction program be financed by a bond issue, if necessary, and proceed at the rate of about $25,000,000 yearly apart from the state's normal program of highway construction and maintenance.

The state department of public works has made studies during the past year as to the location of a proposed superhighway between New York City and Buffalo and has also carried on an extensive survey of the entire state system with a view to laying out a comprehensive six-year program of reconstruction of the state highway system.

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C. R. Olberg Dies

Charles R. Olberg, hydraulic engineer for the PWA, with the Indian Irrigation Service, the Reclamation Service and the War Department and who had acted as consultant for South American governments and the Soviets died in Washington April 4 at the age of 60.

Olberg had charge of the $12,000,000 San Carlos Project in Arizona while with the Indian Irrigation Service. As consultant for the Soviet Government he directed investigation and design of the $200,000,000 Mingechaur irrigation and hydroelectric project on the Kura River.

Housing Project Rent Cut at Columbia

Rents on PWA project in South Carolina reduced as local authority takes it over

The rents charged tenants in the negro section of University Terrace, federal housing project in Columbia, S. C., were reduced about $3 per dwelling unit on March 30, as the project was turned over to the Columbia Housing Authority by Nathan Straus, administrator of the U. S. Housing Authority. The project is one of those built by PWA and turned over to U.S.H.A. at the time that agency was set up.

Rentals, including utilities, in the negro section, which previously ranged from $13.52 for a two-room unit to $20.63 for a five-room group house, have been reduced to a range of $10.27 to $19.54. Total rent and utility charges in the white section remain at the previous figures of $24.50 for a three-room apartment to $32.43 for a five-room apartment.

The $4.50 average space rental per room per month thus set for this project is at a rate calculated to carry the annual operating expenses. The expenditure in constructing the University Terrace project was $690,224. This was provided by PWA under a 45 per cent grant and 55 per cent loan, but since the U.S.H.A. took over Straus has decided that rentals cannot carry the loan, and payments on this have been remitted.

The operating expenses covered by the rental are estimated at a total of $25,051 annually. They include administration, maintenance, insurance, payments to the local government in lieu of taxes, and a sinking fund to replace the buildings.

Three more housing projects have been turned over to local authorities by the U. S. Housing Authority. Hill Creek, $2,110,000 project in Philadelphia, was turned over to the Philadelphia Housing Authority on April 1, in accordance with the terms of the lease, since 50 per cent of the dwellings on the project have been rented. Dixie Homes and Lauderdale Court, Memphis projects, were also turned over to the local Authority on April 1, 90 per cent of the dwellings in these two projects having been rented.

Mississippi housing law

Governor White of Mississippi has signed a measure passed by the state legislature permitting municipalities to participate in the federal housing program.

New earmarkings for ten additional cities amounting to $13,150,000 were announced by Straus on March 30, bringing the number of cities for which funds have been earmarked to 60, and the total fund earmarked to $167,710,000.

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Huge Housing Project Disclosed in New York

Building contractors in New York City and representatives of building trades unions heard Mayor LaGuardia disclose that a privately financed housing project to cost about $50,000,000 is planned in New York. The meeting was called by the Mayor to discuss plans to stabilize labor conditions in the New York City building industry. The Mayor gave no details about the housing project, which, however, is rumored to be Rockefeller financed.

The Mayor pointed out the difficulties in housing construction arising from labor disputes and recommended some form of annual wage.

A few days previously on March 29 Nathan Straus, Housing Authority administrator, announced that the building and construction trades council of New York City had adopted a resolution not to seek wage increases on pending public housing projects while they were under construction.

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New York State May Buy Bear Mountain Bridge

The New York State Bridge Authority is empowered to issue bonds for the purpose of purchasing the Bear Mountain Bridge over the Hudson River under the terms of a bill passed by the state legislature. The span will revert to the state automatically in 1955.

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Parking Meters Tried In Washington

A one-year trial of parking meters in a limited section of Washington, D. C., is assured by final Congressional approval of the District of Columbia appropriation bill. The bill authorizes the district commissioners to install the meters on as many as 16 blocks, selected at their discretion. It is intended to use all available types of meters to determine relative merits.

The parking meter provision aroused considerable controversy and was several times voted down by the House; it was approved in its limited form after insistence by the Senate. The trial period will terminate June 30, 1939, unless extended.

Power Cost Repayment Not to be Guaranteed

Comptroller-General rules district need not assume power cost on Colorado-Big Thompson job

A major obstacle in the path of the Colorado-Big Thompson reclamation and power development in Colorado was removed March 26 when Acting Comptroller-General Richard N. Elliott ruled that advance contracts covering repayment of the federal construction money will be necessary only in respect to the reclamation phase and not for the cost of power.

Authorized under the Reclamation Act, the Colorado-Big Thompson development contemplates diversion of about 300,000 acre-ft. from the Colorado River through a 13-mile tunnel under the continental divide to a tributary of the South Platte. An irrigation district organized under state law is prepared to guarantee the return to the federal government of the $24,800,000 reclamation investment, under a 40-year amortization plan, but the district is prohibited by its charter from engaging in the power business, and therefore cannot assume any obligation for the $6,902,772 tentatively allocated to the development of incidental power.

The Comptroller-General's ruling makes it possible to proceed with plans with the assurance that no legal obstacle will tie up the $900,000 already appropriated from the Reclamation Fund for beginning construction.

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Third Bid Call Issued On Shasta Tunnel

Twice postponed, the opening of bids for the 1,820 ft. railway tunnel under the site of Shasta dam in Sacramento River has been set for April 11. The bid opening was postponed twice on account of the failure of the federal Department of Labor to furnish a schedule of minimum wage rates. The schedule has now been established and furnished to prospective bidders.

The tunnel will be used to carry Southern Pacific R.R. traffic past the dam site in order to permit work on the dam to proceed while a proposed 30-mile railroad line is constructed above the high water level of the reservoir. During a second stage of dam construction, the tunnel will be utilized to divert the flow of the river.

The successful bidder will be allowed 240 days in which to complete construction of the tunnel.

Federal Aid Bill Is Introduced

Present rates of expenditure would be extended through 1941 by Cartwright bill

A revised federal-aid bill authorizing expenditures at the same rate as at present during the fiscal years of 1940 and 1941 and increasing the penalty for diversion of gasoline taxes was introduced into Congress by Representative Cartwright on April 5.

The bill proposed a total expenditure of $230,000,000 for each of the two years; of this sum, $125,000,000 would be distributed to the states for expenditures on the federal-aid road system.

The bill, which is understood to have the unanimous approval of the House roads committee, generally follows the usual pattern but contains a few new features. The penalty for diverting motor vehicle and gas taxes from highway uses is increased from a third of the state's allotment to two-thirds of this amount.

States are given the option of expending part of their federal aid allotment for sanitary and other conveniences along highways or in adjacent publicly controlled recreational areas. The District of Columbia, for the first time, is included among the recipients of federal aid.

Proposed sections, which would have given the Secretary of Agriculture authority to require safety regulations, including drivers' license laws and uniform road signs, as a prerequisite to a state's receiving federal aid, were omitted.

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Retroactive Zoning Law Proposed for D. of C.

Provisions for retroactive zoning are contained in the zoning measure for the District of Columbia which is now pending before the Senate committee for the district. The measure provides that the use of buildings existing at the time of adoption of any regulation drawn under the zoning act of 1920 may be terminated by the zoning commission, either by specifying the period within which non-confirming usage shall be discontinued or by establishing a formula for compulsory termination. Such a formula would be required to allow a reasonable period for recovery of the investment in the non-conforming building.

The bill would also give the commission authority to provide for restoration or reconstruction of non-conforming structures.

Investigating Committee For TVA Named

The personnel of the joint committee that will investigate TVA was announced Apr. 5 by Vice-President Garner and Speaker Bankhead. The former named Senators Donahey, Ohio; Brown, New Hampshire; Schwartz, Wyoming; McNary, Oregon; Borah, Idaho. Representing the House will be Mead, New York; Driver, Arkansas; Thomason, Texas; Jenkins, Ohio; Wolverton, New Jersey.

McNary and Borah immediately declined to serve, the former because of the press of other duties and Borah because he disapproves of "investigations by town meetings."

The committee will select its own chairman. The outstanding candidate is Rep. Mead, who handled the investigation into ocean mail contracts.

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Winners Are Announced In Bridge Contest

Hazelit & Erdal, Chicago consulting engineers, were awarded first prize in the bridge design contest conducted by the American Institute of Steel Construction. The second prize went to Madigan-Hyland, New York City consulting engineers, and Walter W. W. Jones, New York City architectural engineer, received third prize.

The winning designs were chosen from more than two hundred entries by the following board of judges: C. M. Pinckney, consulting engineer and former chief engineer of the Borough of Manhattan, New York City; Albert Kahn, Detroit architect; Paul P. Cret, Philadelphia architect; W. T. Chevalier, vice-president, McGraw-Hill Publishing Co.; Harland Bartholomew, city planner, St. Louis; Loran D. Gayton, city engineer, of Chicago; Paul G. Hoffman, president of Studebaker Corp., South Bend, Ind.

Honorable mentions were awarded to Owen L. Gowman, New York, Max Schlesinger, Division of Highways, Springfield, Ill., E. L. Pavlo, White Plains, N. Y., Hays Simpson Hunsicker, Cleveland, and George D. Recher, Chicago. Gilbert Stanley Underwood, Washington, D. C., and W. E. Reynolds, assistant chief, Procurement Division, Washington, were awarded an honorable mention; Charles M. Noble and Milton Brumer and A. Gordon Lorimer of New York received a joint award, as did F. Dougherty and W. G. Moeckel and L. H. Doane of Wilmington, Del. E. K. Johnstone and L. A. Richardson, Pennsylvania State College, State College, Pa., who submitted five entries, received two joint awards.

Planning Upheld By State Court

New Jersey Supreme Court approves delegation of planning power to municipalities

The power of the state to enforce compliance with community plans and the legality of a 1930 New Jersey act delegating to municipalities the power to set up planning commissions was upheld by the New Jersey Supreme Court on March 30.

The decision was made in a case brought by a real estate firm which was appealing from a decision of the West Orange, N. J. planning board forbidding the company to build a number of dwellings on a tract in West Orange. The company attacked the constitutionality of the planning act on the ground that it violated due process.

Although the court ordered the planning board to review its decision in the case at issue, it threw out the constitutional issue.

Public welfare rules

Antedating the constitution, the court held, "the state possesses the inherent authority . . . to resort, in the building and expansion of its community life, to such measures as may be necessary to secure the essential common material and moral needs. The public welfare is of prime importance and the correlative restrictions upon individual rights—either of person or property—are incidents of the social order considered a negligible loss compared with the resultant advantages to the community as a whole."

The delegation of powers in the 1930 act was legal, the court said, because the act contained a sufficient standard to guide the actions of the local board.

On the particular case at issue, however, the court held that the board had acted in an improper manner. Whereas the decisions of the board should be based on broad considerations affecting the municipality as a whole, the board had given undue weight, in this decision, to the objections of adjoining property owners.

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WPA Aid Said Granted To Pennsylvania Road

The WPA, according to press reports, has agreed to furnish a grant of about $20,000,000 to aid in financing the $53,000,000 toll road from Harrisburg to Pittsburgh along the old road bed of the abandoned South Penn R.R.

WASHINGTON HIGHLIGHTS

Special reports by Paul Wooton

IN A SUDDEN BURST of activity the Senate, on March 25 approved a large number of bills of engineering interest. Bills that had previously passed the House included:

Authorization of a federal reclamation project to supply water to the Arch Hurley Conservancy District in New Mexico.

Authorization of an interstate compact between Idaho and Wyoming apportioning the waters of the Snake River.

Bridge authorizations as follows: A toll bridge across the west passage of Narragansett Bay between Jamestown and North Kingstown, R. I.; free bridges across the Red River of the North near Nielsville, Minn., and between Caledonia, N. D. and Shelly, Minn.; a free bridge across the Delaware River between Port Jervis, N. Y., and Matamoras, Penn.

BILLS not yet acted on by the House included:

Authorization of an interstate compact for the division of waters of the Little Missouri River by Montana, North Dakota, South Dakota and Wyoming.

Allocating net power revenues from the Shoshone hydroelectric plant in Wyoming to a reclamation fund after dam and power system are paid for.

Applying the workmen's compensation laws to employees of federal contractors.

ON THE SAME DAY the Senate public lands committee reported favorably a bill that would divert royalties from naval oil reserves to the Reclamation Fund.

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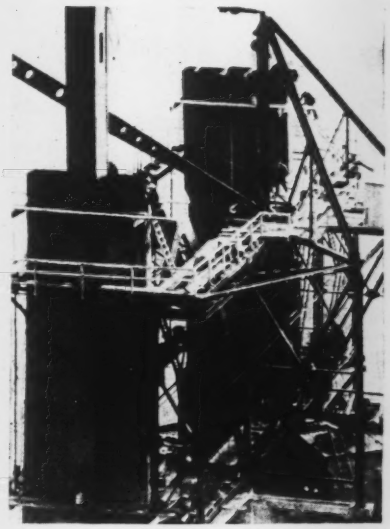
40-Hour Week Requirement Modified in New York

Workers on state projects of a seasonal nature in New York State are permitted to work 48 hours per week instead of the present 40 under the terms of a bill passed by the New York state legislature. The increase in hours would apply only between May 1 and Nov. 15 and only to work carried on outside cities and villages.

The 40-hour week would continue in effect on all work financed in part by federal money because hours of employment on such work are subject to federal regulation.



TOWER FOR LIONS GATE BRIDGE

MASSIVE COLUMNS of steel rise from the south main pier of the Lions Gate Bridge to form a 350-ft. tower for the suspension bridge now under construction across the first narrows, at the entrance to Vancouver Harbor.

Auto Engineers Join C.I.O. Union

The Society of Designing Engineers, an independent organization of automobile engineers with about 2,000 members, has voted to join the Federation of Architects, Engineers, Chemists and Technicians, C.I.O. A referendum of the membership which began on March 15 resulted in a vote of 58 per cent in favor of affiliation.

The society will now function as the auto division of the federation.

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Joint Technical-Arts Course Planned at Carnegie

A five-year program of study combining work in the liberal arts with a technical course has been worked out in a cooperative arrangement between Carnegie Institute of Technology and two liberal arts colleges in Pennsylvania—Allegheny College and Washington and Jefferson College. Students who qualify for the plan will complete three years of prescribed work at one of the liberal arts colleges followed by two years at Carnegie; the program will go into effect next year.

Students transferring to Carnegie will follow an engineering program and will be granted the Bachelor of Science degree by Carnegie and the Bachelor of Arts degree from the cooperating institution.

LABOR NOTES

AN INJUNCTION to prevent plumbers from calling a strike is being sought by Brooklyn master plumbers. The Master Plumbers' Association says that the union has threatened to stop work unless the association reconsiders its decision to discontinue payments to a code authority established more than a year ago to guarantee fair competition.

A COLLECTIVE labor agreement between Montreal construction unions and the Builders' Exchange of Montreal has been renewed for a year. Wage increases, asked by the unions, were not granted. Provision is made for a 44-hr. week with time and a half for overtime.

A NEW CHAPTER was written in the checkered history of the repair work to the St. Charles, Mo., highway bridge as the month ended. On March 30, work which had been halted since February by labor disputes was resumed, after the contractor, Massman Construction Co. of Kansas City, signed a contract with the Independent Workers Organization, a group formed after the strike. Four days later, however, a general strike of 6,000 A.F.L. workmen, protesting against recognition of the independent body, halted the project again.

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N. Y. Legislature Approves Parkway Bill

Six bills calling for special parkway appropriations have been passed by the New York state legislature and sent to the Governor. They provide for an expenditure of $4,043,000 for parkway projects, additional to an appropriation of $3,835,000 which was passed earlier in the session as a part of the regular highway construction program.

The additional measures would provide for parkways in the New York area (*ENR*, Feb. 24, 1938, p. 285) costing $3,575,000. In addition, $438,000 is appropriated for construction of the Lake Ontario Parkway in Monroe county.

The New York City measures include $875,000 for elimination of bottlenecks in the Cross County Parkway in Westchester County, $1,050,000 for the Hutchinson River Parkway, and $1,650,000 for extensions of the circumferential parkway circling the borough of Brooklyn.

News continued on page 517

COMMENT AND DISCUSSION

Readers' opinions on matters that concern the engineer

Tremie Concrete

Sir: In Engineering News-Record of March 3, p. 323 appeared a question by J. Dickson Roots regarding the consistency of tremie concrete.

Having supervised the placing of considerable tremie concrete it has been the writer's experience that most desirable results are obtained where the water-cement ratio is at a minimum, producing a concrete of aproximately 2.5 to 3 in. slump. Enough water added to produce a homogeneous mass is the essential feature, in order that segregation of materials does not occur.

Desired results with tremie concrete are affected considerably by temperature change. Concrete placed according to the methods outlined in the preceding paragraph at a temperature of 65 deg. F. was practically free of voids and cracks. In this case a 1 : 2 : 4 mix was used, giving a strength of 3,250 lb. A higher water-cement ratio and higher temperature produced a finished product somewhat inferior in quality to that where the concrete was of a lower slump and lower temperature.

An added feature to be used in building abutments and piers under water, the writer having reference to this type of construction, is the use of a mechanical vibrator. With a vibrator a very low slump may be used, and a vibrator has great advantages in producing a finished product of high strength.

LEONARD A. WAGNER
General Foreman
Consolidated Engineering Co.
Washington, D. C., March 21, 1938

Sir: Relative to the query of J. Dickson Roots in your issue of March 3, 1938, about the proper consistency of tremie concrete, we have found that the least laitance was formed when we kept the slump between five and seven inches. Our concrete contained seven bags of cement per cubic yard and the sand content was between 40 and 50 per cent of the total aggregate. This concrete was used in pouring seals in seven cofferdams 16 in. x 65 ft. in plan and about 65 ft. below mean sea level. Each pour was made continuously and contained from 1,100 to 1,300 cu. yd. of concrete.

It is believed important that the sand content does not fall below 40 per cent of the total aggregate.

A. L. HERTZ
Asst. to the Municipal Engineer
The Panama Canal
Ancon, C. Z., March 15, 1938

Strain Rosette Technique

Sir: In the article "Interpreting Data from Strain Rosettes," which appears in the March 10 issue p. 366, Professors Beggs and Timby describe a derivation of Osgood's formulas for calculating components of stress from strain-gage measurements on four gage lines. It is well known that only three independent measurements are required to completely determine the state of strain in a two-dimensional system of homogeneous strain. The authors state that "the advantages of measuring four gage lines instead of three have already been pointed out by William Hovgaard and William R. Osgood. . . ." A careful study of Osgood's paper, to which reference is made by the authors, will reveal that Osgood makes no statements as to the relative advantages of the three and four gage line techniques. Hovgaard makes the following statement: "As a check it is advisable to measure the strain also along the other 45-deg. line, and the calculation will be thereby somewhat simplified." This statement is quite true, but its full significance has been overlooked by many recent experimenters. The important part of the statement is that the extra measurement is to be used *as a check*. When Osgood's formulas are used, the advantage of the fourth measurement as a check is completely lost.

In applying Osgood's formulas to a group of four strain-gage readings, only one set of results is obtained, and in this set the fourth measurement has been automatically averaged in with the other three. Obviously no check has been made. If four measurements are to be taken, they should be used in groups of three to calculate the state of stra and the separate results should th be compared. In this way, the ext reading is used as a check of t other three.

Check measurements can also made with a three gage-line rose either by repeating the measu ments or by using successive lo increments. This procedure is cu tomary and advisable in any cas

What, then, is the advantage of t four gage lines? The calculati formulas for three lines are of t same order of simplicity as those f four lines. On this point there is li tle to choose between the two.

The only possible advantage of th four lines might lie in an increase o overall precision of measurement An analysis of this consideration shows that the advantage is small. For comparison, we may take a rosette composed of four lines at 45-deg. and one of three lines at 60-deg. Then, as an example, we may determine the errors introduced in the calculated values of the maximum shearing strain (γ) by equal accidental errors in the measurements. Suppose that the strain readings are uncertain by ± 0.00001, which is reasonable for the type of strain gage used by Professors Beggs and Timby. Then it may be shown that the error induced in γ by the four line method is ± 0.000014 and by the three line method, ± 0.000016.

It seems reasonable to conclude that the slightly higher precision obtained with four gage lines does not compensate for the additional labor involved in taking an extra strain measurement on each rosette, especially since repeated measurements are necessary in either of the cases.

RAYMOND D. MINDLIN
Instructor in Civil Engineering
Columbia University
New York, March 18, 1938

Sir: Dr. Mindlin submitted his letter of March 18, 1938, to the authors of the article under discussion. They make the following comment regarding the use of four gage lines at 45 deg.

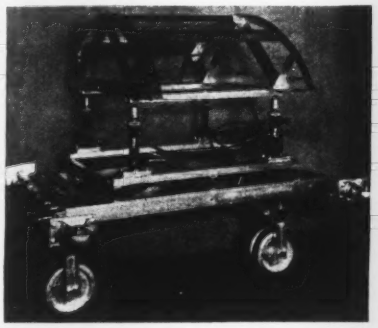
Although the authors did not state how the fourth measurement was used by them as a check of experimental observations, it is nevertheless well known that the sum of the unit strains at 90 deg. is constant. Accordingly, this check was applied before computing any rosette by com-

paring the sum of the 0 and 90 deg. strains with the sum of the 45 and 135 deg. strains. Experience has shown that this is a valuable check of rosette strain measurements, in addition to the check normally provided by the repetition of observations.

GEORGE E. BEGGS
ELMER K. TIMBY
Princeton, N. J., March 22, 1938

Special Truck Speeds Work

Sir: In your issue of Jan. 27, p. 140, there is a very interesting article about construction of the relief sewers in the Aberjona Valley of Massachusetts.



In Fig. 3 a method of placing precast concrete pipe half-sections is shown. This method subsequently was superseded by a special hydraulic-lift truck built by Lewis-Shepard Co. for V. Barletta & Sons, who were the contractors for this section of the sewer. On p. 142 of this article, in the middle column, is a note that the contractor was able to lay seven sections per day. With this hydraulic truck, the day's production was more than tripled. The truck as it left our plant is shown in the accompanying photograph.

H. L. HENCHEY
Lewis-Shepard Company,
Boston, Mass., Feb. 17, 1938

Correction

In the article on the Eau Claire, Wis., waterworks (*ENR*, Jan. 20, 1938, p. 103) the statement was made that no trouble is experienced from electrolysis because direct current is used in the city. This is incorrect; the absence of electrolysis trouble is credited to the fact that *no* direct current is used in the Eau Claire system. —EDITOR

Beam Deflections

Sir: Under date of May 6, 1937, *Engineering News-Record* published a letter from the writer entitled "Beam Deflections by Moment-Area" in which a method was described for conveniently computing deflections of a simple beam by the principles of moment-areas. It was founded upon the two conditions:

1. The static moment of the area of any bending moment diagram about any point of the beam is equal to the sum of the individual static moments of the areas of the bending moment diagrams of the various forces acting upon the beam with reference to the same point.

2. For any force P a distance a from a point, the static moment of its moment diagram area about this point will equal

$$(P\,a)\left(\frac{a}{2}\right)\cdot\left(\frac{a}{3}\right)=\frac{P\,a^3}{6}$$

(See Fig. 1)

It was stated that the method was not applicable to uniform loads. This statement is subject to correction. The principle may be readily applied to a uniform load of w per lineal unit by considering the load made up of a series of elementary loads each equal to $w\,dx$ and each a distance x from the point of deflection. Thus the static moment of the moment diagram of the uniform load about the point will equal

$$\int_{s_2}^{s_1}\frac{w\,x^3\,dx}{6}$$

where s_1 and s_2 are the distances from the point of deflection to the ends of the load. The static moment of the vertical reaction and of the moment reaction due to the uniform load must, of course, be properly included.

The principle, while described with reference to a simple beam, is equally applicable to a cantilever beam. Thus, for the case shown in Fig. 2a, the deflection of any point C with reference to a tangent through B will be

$$\frac{R\,b^3}{6}-\frac{M\,b^2}{2}-\frac{\Sigma\,P\,a^3}{6}-\int_{s_2}^{s_1}\frac{w\,x^3\,dx}{6} \qquad (I)$$

x, a, b, s_1 and s_2 being measured from C.

Any loads between C and the free end A are obviously without effect upon Δ_c except for their influence upon R and M.

A further development of this same principle enables us to compute the change in slope between any two points of the beam. Thus, between B and C the change in slope will be

$$\frac{R\,b^2}{2}-M\,b-\frac{\Sigma\,P\,a^2}{2}-\int_{s_2}^{s_1}\frac{w\,x^2\,dx}{2} \qquad (II)$$

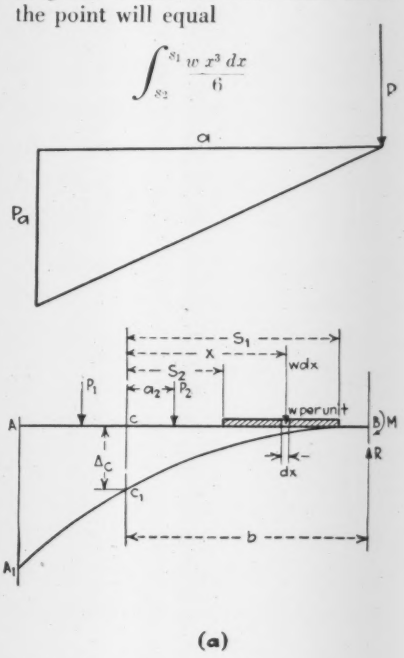
since the area of the moment diagram of any load P with reference to a point distant a from it will be

$$\left(P\,a\right)\cdot\left(\frac{a}{2}\right)=\frac{P\,a^2}{2}$$

See Fig. 2b.

The foregoing equations (I) and (II) thus permit the computation of either the deflection or the change in slope between any two points of a cantilever beam carrying any system of loads by the principles of moment-areas without constructing or even considering the actual bending moment diagram.

FRANCIS P. WITMER
Director, Department of Civil Engineering
University of Pennsylvania
Philadelphia, January 18, 1938



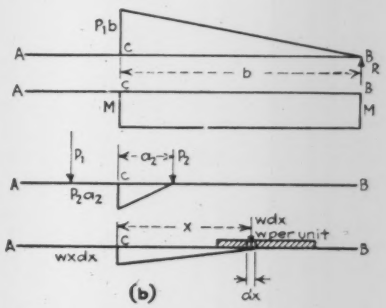


Fig. 1 (above, left) and Fig. 2, illustrating Professor Witmer's correspondence.

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Editorial Offices at 330 West 42nd Street, New York

APRIL 7, 1938

SHEET-METAL SILHOUETTES of schoolboys set in the middle of the road at school zones are becoming a common sight. Generally these devices are placed by local civic or parent-teacher groups and are tolerated rather than approved by the state highway authorities. With all respect to the sentiment that inspires it, this and other extra-official safety marking and signaling of the road should be stopped. A recent survey by the Illinois highway department of traffic at places where silhouette figures and portable traffic lights had been set up indicated "even greater hazards with the signs than without them". Road signs and signals should be as few and as uniform as they can be made; multiplicity and variety merely confuse the driver as to what he must do for safety, and tend toward disregard of all signs. The traffic engineer has been a long time in coming to this conviction, so that the accident-conscious teacher and parent cannot be censured for believing that more signs mean more safety. The remedy lies in state-wide control by the highway department of all road signaling and marking, to the end that an effective, simple and uniform system be established.

Information in Sight

THE TVA INVESTIGATION voted by Congress is certain to bring out much needed information about an enterprise in which every citizen has invested a substantial sum of money through his tax payments. The facts to which the public is entitled and which it did not get and could not get in the star-chamber hearing at the White House will be laid bare. While many details of the five-year history of the enterprise deserve exploration, their chief value will be to throw light on the ability of a government agency to do a good administrative job. Government conduct of business will be on trial; its efficiency, fairness and wisdom will be tested. From this standpoint the comparison that has been made with the investigation which involved Teapot Dome is hardly adequate, for this latter was concerned only with a single official's fitness. The TVA affair revolves around the much broader question of whether the government is competent to manage large enterprises so large in scope and so closely related to human and business interest as development of a great river and reconstruction of a region. We need to know...

Basic Control

CURRENT ANIMOSITIES may easily inspire the thought that no more money should be squandered on TVA expansion, and that therefore the plan to build a large dam at the mouth of the Tennessee River should be rejected. Such a thought would be unfair. It would ignore the fact that the Gilbertsville project mainly serves to reduce Mississippi River floods. Of course the big reservoir would also improve navigation on the Mississippi, as well as open up the Tennessee itself; but the flood-control effect remains the commanding argument. Back of this situation lies a simple but compelling reason. The truth is that the whole Mississippi River control plan is a failure insofar as the city of Cairo and the basins immediately below are concerned; in last year's flood the city escaped destruction only by a hair. Gilbertsville would provide a safety margin by cutting 2 to 4 ft. off Cairo flood heights—not enough in the biggest flood, but a very considerable approach to full protection. It would be the first piece of effective tributary control, and one of the largest, in the ultimate Mississippi River system. The estimate of flood benefits reported by Carl A. Bock on another page, approaching $100,000,000, reflects its importance and emphasizes that the project deserves earnest consideration.

The Shopping Instinct

IN THE CEMENT-PURCHASE ORDER promulgated by the Treasury last week at Presidential direction, Uncle Sam reveals himself as an inveterate shopper. He does not like to pay the market price for goods but wants to go around the corner to the cut-price store. Like the familiar old lady with an incurable shopping instinct he is entitled to indulge himself in this whim so long as it does not involve others; when it does, the matter becomes more serious. The situation is this: Cement, like flour, eggs, steel and other staples has a current market price that is the resultant of competition by various suppliers to share in the total buying at a figure that will enable them to stay in business. The current price naturally varies in different markets—main consuming or trading centers—and at a given trading center different suppliers must make the same price, regardless of how far they come to market. That is a normal manner of doing business, one that has existed since the world first began to trade. When, as now, demand is small and many suppliers are eager to increase their volume, a single large buyer is tempted to shop, feeling that he can exert

enough pressure to break the market, the suppliers taking a loss rather than getting no business at all. In NRA days this process was known as "chiseling", an evil that the NRA was largely set up to check. It is a novelty to find the government now setting up an organized chiseling system—a nice illustration of the double moral standard, or else of the extent to which the shopping instinct can follow men from private life into public office.

Toward Better Cities

A POWERFUL AND POSITIVE WEAPON would be provided for city planners if the terms of a District of Columbia zoning measure now before Congress were generally adopted. This bill would permit the zoning commission to order termination, within a reasonable period, of zone violations in existence when zoning regulations were drawn. Radical in sound, the principle is said to have been upheld in Louisiana courts, and a recent New Jersey Supreme Court decision upholding the constitutionality of civic planning appears broad enough to apply to the proposed statute. The bill offers a means to speed the effectiveness of planning measures which now must wait upon the natural elimination of improper structures or uses. Its widespread adoption would seem an important step toward remedying the inefficiencies characteristic of the layout of most American cities.

Power Along the Border

CANADIANS recently were told quite bluntly by Secretary Hull that if they want to generate power at Niagara from the 1,200 sec.-ft. of water to be dumped into Lake Superior from the Hudson Bay watershed they must agree to a plan for developing the St. Lawrence River for power and navigation. The United States Government wants no piecemeal changing of the Boundary Waters Treaty of 1909, it appears. The issues involved deserve attention.

The treaty revision proposed by Canada is closely tied to a plan, originated by the premiers of Ontario and Quebec, under which the Dominion Government would control the export of power and would negotiate with the United States for such export. Quebec has an excess of power, which Ontario would take to replace power exported by it to New York. At present there is no international agreement concerning the interchange of power, though power has been imported to the United States at Niagara for many years. Now that power export has been taken up as a matter of national concern in Canada it is to be assumed that any revision of the 1909 treaty will include both power export and water diversion by both countries at all points along the Great Lakes-St. Lawrence frontier.

The 1909 treaty needs revision. It allocated 36,000 sec.-ft. to Canada for power development at Niagara and only 20,000 to the United States, chiefly, it is believed, because part of the power generated on the Canadian side was being exported to the United States, and partly because of the 10,000 sec.-ft. then being diverted at Chicago, although neither is specifically mentioned in the treaty. Since 1909 Canada's diversions through the enlarged Welland Canal for navigation and power have increased, while the Chicago diversion has been cut to 1,500 sec.-ft. In fairness it would seem desirable to allocate to the United States the 8,500 sec.-ft. no longer diverted at Chicago plus an amount equal to that drawn through the Welland Canal for power purposes.

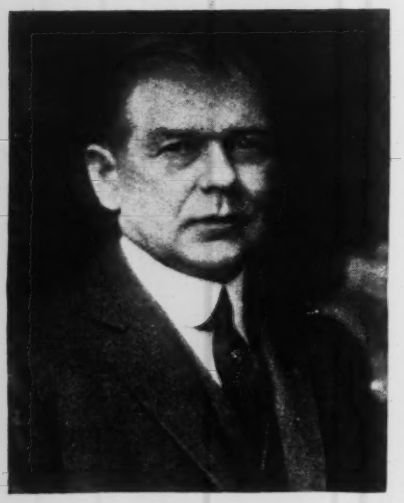
But to do this would seem to require remedial works above Niagara Falls, as has been proposed for many years past, for increased draft on the American side with fully maintained draft on the Canadian side would unquestionably be detrimental to the beauty of the falls. As a matter of fact, the remedial works are so badly needed at the present time as to warrant independent action, though consideration in connection with water diversion for power purposes appears more logical.

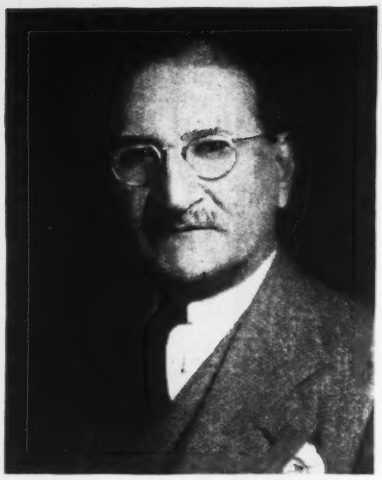
Increasing the diversion on the American side would promote higher efficiency of water use at Niagara Falls since it would open the way for an overall development in which water would be carried from above the falls to a point below the rapids, much as is now done in the Queenston plant in Canada. Addition of this power to the resources of New York would postpone the time when the state will need the power provided by navigation dams on the long-debated St. Lawrence seaway.

Canada does not want the St. Lawrence seaway, and has no present use for the power this project would provide. It is doubtful, therefore, whether any amount of pressure on the part of the United States government would result in favorable action on Secretary Hull's proposal that treaty revision be made to include the whole question of power and navigation along the international border. On the other hand, the United States would benefit by a limited revision of the Boundary Waters Treaty, such as the Canadians propose.

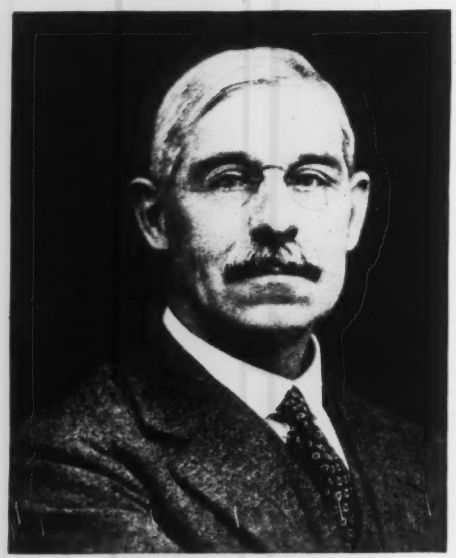
Under these circumstances, the U. S. Government would do well to reconsider its edict that it wants the St. Lawrence Waterway Treaty or nothing. There is little chance of having the waterway treaty approved on either side of the border; there is a fair chance that a revision of the Boundary Waters Treaty to cover both power interchange and water diversion at Niagara could be made acceptable to both countries.

PICTURES IN THE NEWS





RECIPIENTS of A.W.W.A. AWARDS. Honorary memberships will go to Theodore A. Leisen, Omaha (above, left) and Ralph W. Lawton, Los Angeles, (above, center) at the A.W.W.A. meeting in New Orleans April 24–28. Vance C. Lisher, St. Louis (upper right) will receive the John M. Goodell prize, which was established by Engineering News-Record, *and William C. Mabee, Indianapolis, (right) will receive the Diven Memorial Medal.*



RICHARD J. DURLEY (above) secretary of the Engineering Institute of Canada for the past 14 years, has been made secretary emeritus. He is succeeded by L. Austin Wright of Montreal (right).

Navigation and Flood Control at Gilbertsville

by CARL A. BOCK

Assistant Chief Engineer, Tennessee Valley Authority, Knoxville

Key element of Tennessee River Control, Gilbertsville Dam would provide great flood-control benefits and open up an extensive waterway network

CONTINUED INVESTIGATIONS of the much-discussed Gilbertsville reservoir on the lower Tennessee River by the Tennessee Valley Authority conclusively establish the feasibility of this project and point to the importance of its early construction because of the extraordinary ability of this reservoir to reduce flood heights on the Mississippi River.

Gilbertsville Dam is the farthest downstream of the series of dams planned by the Tennessee Valley Authority for the unified development of the Tennessee River. The dam site is about 22.5 mi. upstream from the confluence of the Tennessee with the Ohio River at Paducah, Ky., and is about 184 mi. below Pickwick Landing dam, now practically completed. It is about 69 river miles from Cairo, Illinois. The dam site is within the navigation pool of Dam 52 on the Ohio River, about 27 mi. downstream.

The normal pool area of the Gilbertsville reservoir is 160,000 acres; the area of flooded lands is about 136,000 acres—about one-half agricultural land, while that on the slopes has only nominal value. The area is thinly populated. Practically no important industries will be affected and no mineral lands nor valuable timber will be inundated.

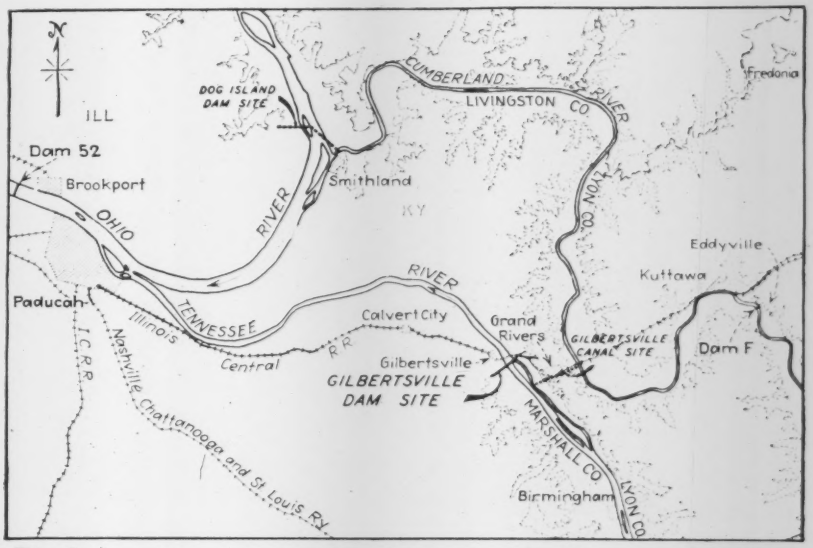


Fig. 1. From the narrow neck closed by the Gilbertsville Dam the Tennessee is to be backed up 184 mi. to Pickwick Landing.

Development of the project

When the Tennessee Valley Authority, as instructed by Congress, began to study 9-ft. navigation on the Tennessee from its mouth to Knoxville, considering also flood control and power possibilities, it was evident that a dam would be required on the lower Tennessee. Extensive studies and investigations were directed towards locating a suitable site, and four sites which appeared feasible were subjected to thorough study. In addition to Gilbertsville there were the Shannon, Aurora, and Birmingham sites, 59, 43, and 29 mi. above the mouth.

The flood plain along the lower Tennessee River is comparatively wide, and subsurface conditions are complicated by ancient river channels in the underlying rock, so that feasible dam sites are not readily available. All of the sites investigated present difficulties of design and construction. Conditions at Gilbertsville proved to be somewhat more favorable than those encountered at the other sites. Further, the location of the Gilbertsville site with respect to the Ohio and Cumberland rivers and possible future projects that may be developed on those rivers has been the largest single factor in the location of the dam.

Arthur E. Morgan, in an article, "Flood Control by Reservoirs" (*ENR* Aug. 12, 1937, p. 263) described the necessity for considering the location of the Gilbertsville Dam with relation to a possible dam on the Ohio River near Paducah. If the best location for such an Ohio River dam were below the mouth of the Tennessee River, the Gilbertsville dam would not be necessary, since the Ohio River dam would back water up the Tennessee and create the required navigation pool. But investigation indicated that the most feasible overall project would include two dams, one across the Tennessee at Gilbertsville and another across the Ohio at the Dog Island site, above the mouth of the Tennessee but below the mouth of the Cumberland.

Investigations and design

Extensive foundation explorations have been carried out at the Gilbertsville site. Some 20,000 lin. ft. of core drilling have been completed, test pits have been dug to rock, and the character of the overburden and foundation rock have been investigated; both rock and earth foundations are suitable.

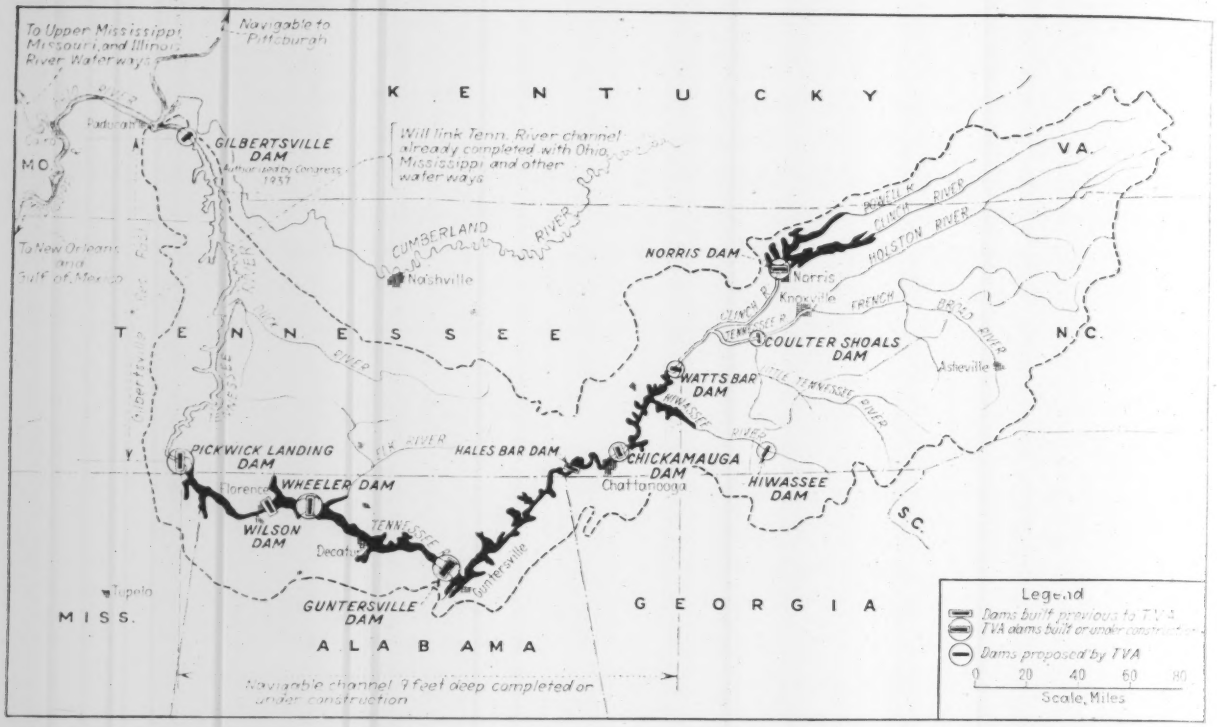


Fig. 2. At the cross-roads of important waterway systems, Gilbertsville Dam is a key item in navigation development on the Ohio-Tennessee-Missouri-Mississippi river system

Structural design has progressed to the point of development of a feasible and economical design. The dam will consist of a 1,210-ft. concrete spillway, with navigation lock and powerhouse sections adjacent, flanked by earth embankments extending to the abutting hills, a total crest length of 8,600 ft. The maximum height of the concrete spillway section from rock to top of operating platform is 145 ft., while the earth embankments will reach a maximum height of about 65 ft. The lock chamber is 600x110 ft., with a maximum lift of 68 ft. The spillway will be equipped with control gates of the fixed roller type, capable of passing 960,000 sec.-ft., which is more than double the greatest flow on record.

No immediate power installation is contemplated, but intakes will be constructed to provide for ultimate future installation of six units with total rated capacity of 192,000 kw. Under unified operation of the TVA system this power development will add 70,000 and 80,000 kw. of prime power to the system, depending on the amount of storage eventually developed upstream. Secondary power will vary from about 40,000 to 100,000 kw. available 80 per cent of the time, depending on the seasonal water supply, the pool level finally adopted, and the upstream storage.

Surveys, appraisals and estimates place the total project cost, including hydroelectric machinery, at $112,000,000.

Gilbertsville is a multiple-purpose project and is planned to be operated in the interest of flood control and navigation, with power incidental. Normal pool level is planned to be El. 359, which is 57 ft. above the level of the downstream navigation pool created by Dam No. 52 on the Ohio River. Flood storage level, for all except extreme superfloods of rare occurrence, is El. 375, which height will be reached only infrequently. However, if any flood should occur large enough to produce a discharge of 2,600,000 sec.-ft. at Cairo, water could be stored to El. 380.

The plan of operation contemplates drawing the reservoir down at the beginning of the flood season to the lowest level consistent with navigation; there will usually be sufficient flow in the river so that the reservoir may be drawn down to El. 350 without adversely affecting navigation. Under such operation, maximum flood storage will be available during the critical flood period, in anticipation of severe floods in the Ohio and Mississippi. The large storage capacity, which will reduce great floods more than 2 ft., will be available to reduce smaller floods as much as 5 ft. or more. For floods coming in late April or May, reservoir capacity can be used safely to the fullest extent because of the practical certainty that there will be no succeeding flood so late in the year—and late floods are the ones that do the most damage to crops.

In Spring, after danger of extreme floods is over, reservoir will be permitted to fill to normal pool, El. 359. The water level would then be gradually drawn down to El. 354 during the dry period to meet the requirements of Mississippi River navigation, effective malarial control, and generation of power.

Flood control value

Gilbertsville is within one day's flow from Cairo, the head of the lower Mississippi Valley, which means positive effect on the control of floods at and below Cairo. The Ohio River is the largest contributor to extreme floods in the lower Mississippi, and the Tennessee is the largest tributary of the Ohio. With a

great storage capacity available for regulation of flood flows from the 40,000 sq. mi. of watershed above Gilbertsville, this project is the most favorably located of any now contemplated for the Mississippi.

By virtue of its large capacity located so close to Cairo and the head of the Mississippi Valley where protection is needed, and of the existing physical conditions which make construction possible without harmful or costly interference with existing features, Gilbertsville reservoir presents an unusual opportunity for positive and economical flood control. If it is not taken advantage of, this great resource, which can not be duplicated at any other location, may be dissipated by other uses which will destroy its flood control value.

Fig. 4, a volume curve for the reservoir, shows that between El. 350 and El. 375 there are 4,600,000 acre-feet of flood storage. If any flood beyond present reasonable expectancy should ever occur, an additional volume of 1,450,000 acre-ft. from El. 375 to El. 380 is available.

The Army Engineers in their report on a comprehensive reservoir system for control of Mississippi River floods (House Document No. 259, 74th Congress, 1st Session) allocate to the Tennessee Basin a total flood storage of 10,589,100 acre-ft. Gilbertsville Reservoir will provide a large portion of this storage, and will provide it practically at the head of the lower Mississippi Valley.

An analysis of past floods indicates that the reservoir with storage to El. 375 will reduce the stage of large floods by amounts varying from 2.3 to 2.8 ft. at Cairo, and reduce the discharge by from 184,000 to 220,000 sec.-ft. (the amount varying for different floods. Analysis of hypothetical maximum floods having a discharge of 2,600,000 sec.-ft. at Cairo and storing water in Gilbertsville to El. 380 indicates reductions of 2.3 ft. to 3.8 ft., depending on the shape of the flood crest. It is concluded, therefore, that the Gilbertsville Reservoir will reduce the stage at Cairo for large floods by 2.3 ft. or more, and will reduce the discharge by 200,000 sec.-ft. or more.

As the Tennessee River discharges into the Ohio River near its mouth, the crest of the Tennessee flood wave is generally in advance of the Ohio River crest. For this reason the water which spreads out over the flood plain on the rising stage in the Gilbertsville reach passes out on the falling Tennessee River stage, adding to the Ohio River crest. This was the case to a marked degree in the January-February flood of 1937. After the Gilbertsville Reservoir is built, a portion of its stored water can be released in the early part of the flood period, when there is ample capacity in the river below, and a large portion of the Tennessee River flow during all floods, and all of it during many floods, can be retained as the Ohio crest passes.

Construction of Gilbertsville Dam will not reduce the valley storage for Ohio River floods, since past experience shows that there has been sufficient Tennessee River floodflow to prevent backwater entering the Tennessee from the Ohio River.

Gilbertsville further provides cheaper regulation of floods, whether measured by cost per acre foot or by cost second-foot of flow-reduction, than do any other reservoir storage possibilities. Thus, in controlling floods greater than 2,250,000 sec.-ft. at Cairo by reservoirs on the Ohio River and on the Missouri and Middle Mississippi, as set out by the Chief of Engineers, U. S. Army, in Flood Control Committee Document No. 1, 75th Congress, which respectively provides storage capacities of 11,261,000 and 11,480,000 acre-ft., the figures are:

COMPARATIVE COSTS OF FLOOD REDUCTION

Location of Reservoirs	Reduction in sec.-ft. at Cairo	Cost Per sec.-ft. of reduction
Ohio River.....	200,000	$1,230
Missouri River and Middle Mississippi ...	140,000	1,006
Gilbertsville	200,000	560*

* Includes all costs for navigation and power as well as for flood control.

The Gilbertsville Dam will complete the canalization of the Tennessee River between Paducah and the upper

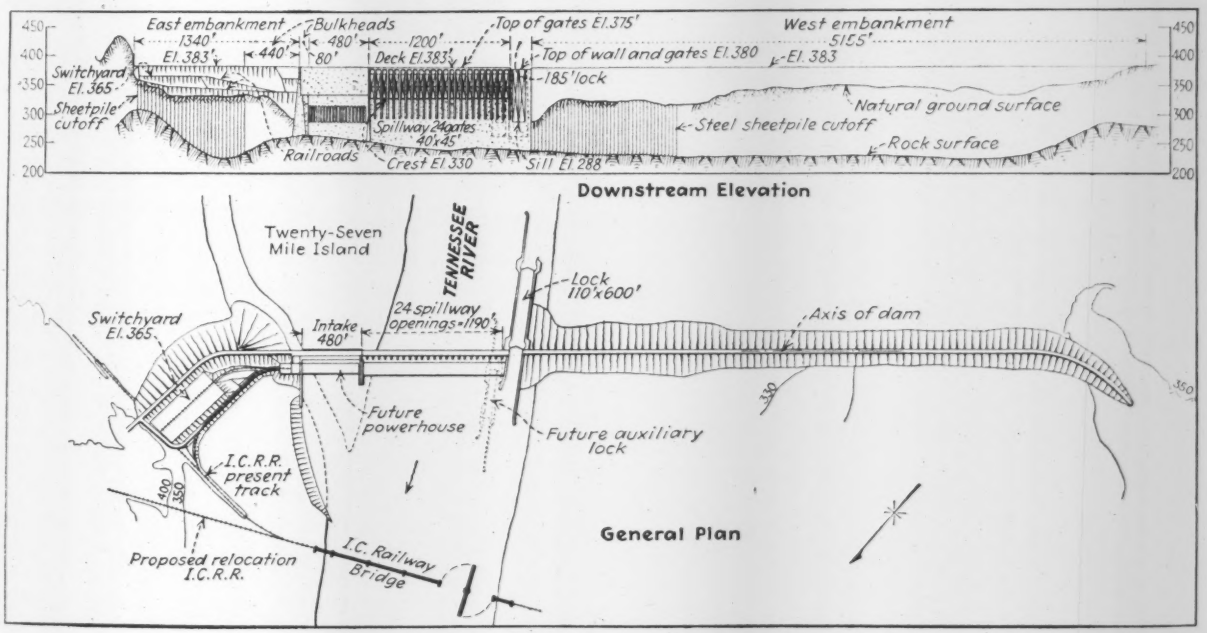


Fig. 3. **A concrete spillway across the river channel flanked by earth embankments giving a total dam length of a mile and a half would raise the water level at Gilbertsville 68 ft.**

end of the Chickamauga pool, about halfway between Chattanooga and Knoxville, a total distance of 520 mi. It will create a pool 134 mi. long that will provide 9-ft. navigation from the Ohio River at Paducah to Pickwick Landing Dam with only one lockage. Thus the Gilbertsville Reservoir pool will enable the Tennessee River to take its place as an important part of the main trunk navigation system of the Mississippi Valley which includes the upper and lower Mississippi, the Ohio, the Cumberland, Illinois and Missouri Rivers.

In planning the project, consideration was given to the alternative of building low navigation dams on the lower Tennessee River. Four such dams would be required, which would mean four lockages as compared with one for a high dam. The navigation channel provided by the high dam pool is wider, deeper and less tortuous. Fluctuations in river levels are greatly reduced, and substantial savings in construction and operation of navigation terminals are obtained. The large reservoir will further permit re-regulation of discharge from upstream reservoirs and will materially increase the amount of water available for dry-season navigation in the lower Ohio and Mississippi Rivers; it will assist in controlling flow from the Tennessee to mitigate sudden rises in the Mississippi River which interfere with navigation. Because of these marked advantages, the high dam project is preferable to the several low dams from the standpoint of navigation alone, and when it is considered that the low dams have no flood-control effect, whereas the high dam project has a highly valuable effect, the latter's advantage is obvious.

The long reservoir pool, with some reaches of several miles nearly straight, has raised question as to the effect of waves and rough water upon navigability by boats of the type now in use on the Mississippi and Ohio Rivers. Careful studies show that these craft will find navigation easier on the Gilbertsville pool than on the lower Mississippi. There are stretches of open water on the Mississippi between Cairo and Memphis 12 to 18 mi. long, where winds and waves have full play to accomplish maximum effects. It is believed, therefore, that such effects will not be greatly different on the two bodies of water.

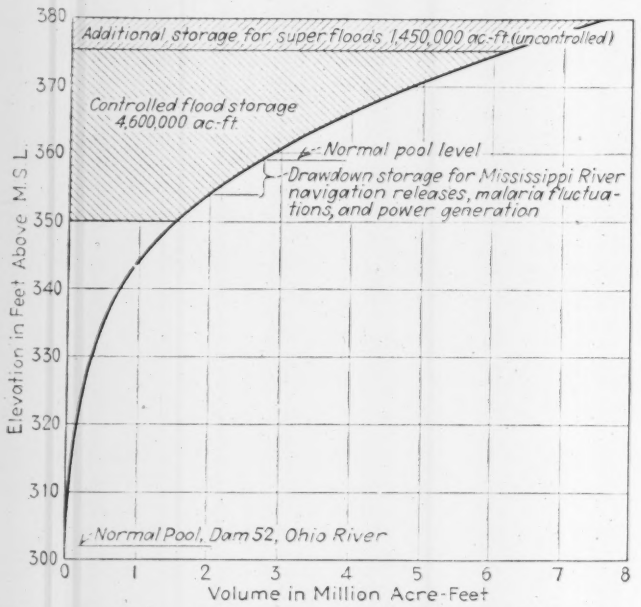


Fig. 4. Ultimate flood storage provided by Gilbertsville Reservoir exceeds 4 million acre-feet.

The Gilbertsville Reservoir has marked advantages over the Mississippi River in other matters important in navigation. In the Mississippi, there are crossings where fast water is encountered, with velocities up to 8 or 10 ft. per sec. coupled with treacherous currents. Upstream tows frequently must be broken and taken over these crossings a few barges at a time. At best, navigating the crossings is difficult. The natural current of the Mississippi of 2 to 3 m.p.h. must also be contended with by upstream navigation.

Large flood control benefits

A detailed study of the value of flood-height reduction to the alluvial valley of the Lower Mississippi River has been made by Principal Engineer C. W. Okey, of the Authority engineering staff. He has considered the several kinds of benefits that will accrue to the lower Mississippi Valley for a reduction of 2½ ft. in the flow line of a flood of the magnitude of 2,600,000 sec.-ft. at Cairo. These include the increase in land values that would result from complete protection, the benefits that would accrue to cities, the saving in costs of raising railways and highways, capitalized value to lands in floodways from fewer overflows, capitalized value to unprotected lands as a result of lesser flooding, capitalized value of benefits from lessened seepage damage to farm lands, and reduction in levee maintenance costs. Considering only the benefits which may be directly attributed to the Gilbertsville Reservoir, the value of that reservoir in protection to lands and improvements in the upper portion of the alluvial valley of the Mississippi River has been conservatively estimated to be approximately $90,000,000.

In addition, there would be many intangible benefits, such as the savings in human life, lessening of interruptions to commerce and communications, and other matters which are not readily susceptible of monetary evaluation. The total benefits substantially exceed the portion of the cost of the project which should be allocated to flood control.

The project is being reviewed from time to time by consulting engineers and geologists, including J. L. Savage, U. S. Bureau of Reclamation, Denver; L. F. Harza, Chicago; C. H. Locher, New York; C. H. Paul, Dayton; O. N. Floyd, Dallas; Warren J. Mead, Boston; C. P. Berkey, New York; and L. C. Glenn, Nashville. These consultants have been in contact with the project practically from the beginning and have advised regarding location of the dam and the major features of design.

A special review of the flood-control aspects of the project was made by consulting engineers L. L. Hidinger, Memphis; O. N. Floyd, Dallas; and E. W. Lane, Iowa City. These consultants have approved the flood-control features of the Gilbertsville project and are in agreement as to the unusual and unparalleled value of the project in the protection of the lower Mississippi Valley from disastrous floods.

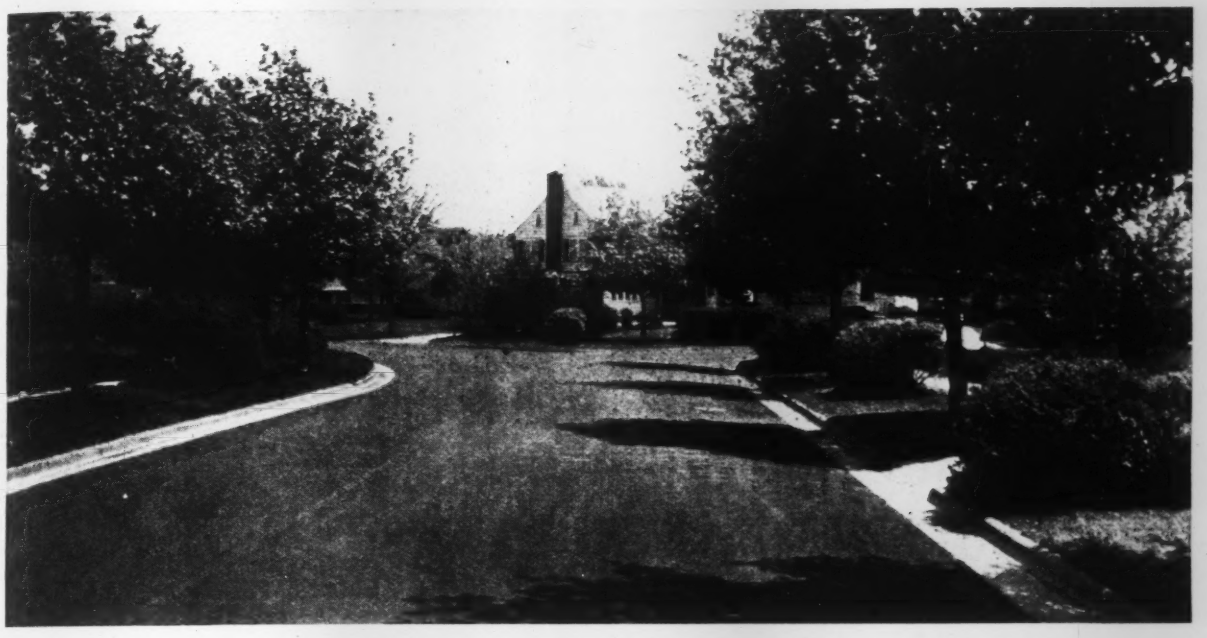


FIG. 1. GOOD APPEARANCE AND SMOOTH RIDING QUALITIES CHARACTERIZE THIS LOW-COST STREET IMPROVEMENT

Quality Streets at Low Cost

Lansing, Mich., uses monolithic concrete curbs and gutters and an oil aggregate surface mixture on a gravel base for street improvement

MAKING a little money go a long way in street improvement, Lansing, Mich., has been surfacing 12 to 15 miles of 30-ft. width thoroughfare each year since 1931 with an oil aggregate mixture costing only 38 cents a square yard. In addition to low cost, this type of paved surface has shown remarkable service qualities, particularly in its resistance to winter deterioration. The oldest pavement, now in place for seven seasons, has shown no signs of cracking despite several severe winters, and thus far has been treated with only one seal coat.

Aggregate and oil

The oil aggregate surface, developed by S. C. Jacka, city engineer, is applied on gravel base streets. It consists of a mixture of asphaltic road oil and mineral aggregate, thoroughly mixed in the city-owned asphalt plant and spread evenly over the prepared base.

The mixture is composed of 25 per cent gravel and about 75 per cent sand to which is added about 18 gal. per cu. yd. of cracked road oil.

The aggregate, which is uniformly graded from fine to coarse, conforms to the following requirements for grading:

Passing 1 in. screen circular opening	100%
Passing ¼ in. screen	60 to 80%
Passing 10 mesh	40 to 60%
Passing 200 mesh	5 to 10%

Sand is added to the pit or crusher run product to supply any deficiency in the 10 mesh size, and filler dust (commercial silica dust) is added to supply any deficiency in the 200 mesh material.

The asphaltic oil is designed to meet the following requirements:

One hundred penetration asphalt plant content, 75 to 85 per cent; ductility of asphalt content at 77 deg., not less than 100 per cent; specific gravity at 60 deg., not less than 1.02 per cent; soluble in carbon disulphide, not less than 99.0 per cent; loss in 5 hours, (325 deg. F. 60 grams) not more than 8 per cent; flash point (open cup) not less than 225 deg. F.; furol viscosity, (140 deg. F.) 200 to 350 sec.

Construction methods

Only well compacted gravel streets are selected for surfacing with this mixture, and preference is given to those streets with curb and gutter constructed. The minimum thickness of the gravel base, which is bound with clay, is not less than 6 in.

The gravel surface is scarified to a depth of 2½ in. and the loosened surface bladed by a power grader to a windrow in the center of the street and hauled away in trucks. A minimum amount of gravel is trimmed from the center of the roadbed depending on the existing crown of the street. At the road edge, the surface is cut about 2½ in. below the concrete gutter. After the base has been cut smooth and properly crowned from the center to the gutter line, it is thoroughly rolled with

Fig. 2. First steps in laying the oil aggregate mixture. The mix is hauled to the job by truck and spread by a power grader.

Fig. 3. Uniform thickness of the finished surface is secured by the use of a power grader which spreads the mix to a depth of 3 in.

Fig. 4. Compaction of the mix is accomplished with a 10-ton tandem roller. Edges along the gutter and around manholes are carefully tamped by hand.

a 10-ton, three-wheel type roller.

The oil mix prepared at the asphalt plant is hauled by truck to the prepared base and spread by a power grader to a uniform depth of 3 in. The edge along the concrete gutter and around manholes is tamped by hand, and the finished surface struck off by the power grader to a uniform thickness. The street is then closed until ready for rolling.

After the mixture has become thoroughly cooled, it is carefully rolled by a 10-ton tandem roller; this is usually done during the cool part of the day. When the mixture is thoroughly compacted the street is immediately opened to traffic. The surface is then rerolled from two to four times on successive days.

Preparation of mixture

In preparing the mixture, the aggregate and silica dust are measured separately and accurately by weight for each batch to be mixed. The asphalt oil, heated to a temperature of 160 deg. F. is measured for each batch by actual weighing with scales attached to the asphalt bucket. If the gravel is not reasonably dry, it is heated in a revolving drier sufficiently to remove moisture before mixing.

The mixture is made in a twin pug mixer by first charging it with aggregate and silica dust. After the two have been thoroughly mixed, the asphalt road oil is added and the mixing continued for a period of not less than 45 seconds. The quantity of oil added varies between $1\frac{1}{2}$ and 5 per cent by weight of the total mix, depending upon aggregate grading.

This type of surfacing requires relatively little maintenance. Experience thus far has shown that after about four years of service a seal coat should be applied, and this can be expected to keep the pavement in good shape for a five-year period. The seal coat used in Lansing consists of a 0.3 gal. per sq. yd. application of either light tar or cutback asphalt; over this is spread a dressing of $\frac{3}{8}$ in. stone chips at the rate of 22 lb. per sq. yd.

Curbs and gutters

Street improvement projects include not only the laying of pavement but the construction of curbs and gutters as well. The cost of the pavement is defrayed with money received by the city from the state weight and gas tax fund; this amounts to about $150,000 yearly, part of which is applied toward maintenance. Curb and gutter construction, however, is assessed against the property benefited, the city paying 20 per cent of the cost.

Curbs and gutters are cast mono-

lithically in 10-ft. sections, separated with a 1-in. premolded expansion joint every 50-ft. The concrete mixture consists of 60 per cent ¾ in. gravel and 40 per cent sharp sand, to which is added six bags of cement per cubic yard of aggregate. Steel forms are used to make the section shown in Fig. 5.

All the work is done by the city engineering forces and the cost has averaged about 82 cents per lin. ft. The cost figure includes rental charges for equipment owned by the city and is based on relatively high labor rates. An idea of the latter is gleaned from the fact that common labor receives 67½ cents per hr.

An accurate set of records is kept on all street and gutter construction so that both cost and quantity data are available for quick reference. These records are made on printed cards, samples of which are shown in Fig. 6. The pavement record is so designed that it provides complete information on the type and quantity of materials used, the physical characteristics of the street, and the maintenance required. The curb and gutter record is designed to serve as a daily report.

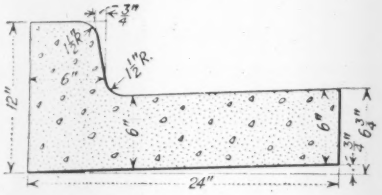


Fig. 5. Cross section of the monolithic concrete curb and gutter.

OIL AGGREGATE PAVEMENT

Street ..... Year .....

From ..... to .....

Width ..... Length ..... Yardage .....

Depth ..... Cost per sq. yd. .....

Condition of base .....

Kind of oil used ..... Vis. ..... Asp. Content .....

Seal Coated in ..... with .....

..... Gal per sq. yd. with ..... lbs. ..... stone per sq. yd.

Further Maintenance .....

CITY OF LANSING—ENGINEERING DEPARTMENT
DAILY REPORT OF CURB AND GUTTER CONSTRUCTION

Date ..... Order No. ..... Weather .....

Location of Work ..... Street from ..... to .....

Number of Lineal Feet Finished .....

Number of Sacks Cement Used ..... Sacks Returned .....

Yards of Gravel Used .....

Yards of Sand Used .....

Number of Men, Including Foreman ..... Average Rate .....

Hours Worked .....

Foreman .....

If remarks on other side check here ( )

Fig. 6. Careful records are the means for developing an accurate history and cost data system. Lansing uses the above for street improvement work.

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Greenbelt Town In England Offers Lesson For U. S. Planners

OPENING of Greenbelt, Md. to its "first settlers" last fall launched the country on its experiment with building towns from "scratch" according to a plan embodying modern principles in design and construction features. Similar new communities outside the cities of Milwaukee and Cincinnati are now also in the making.

As Greenbelt starts the wheels of its first government moving, with modern, low-rent dwellings provided for its 885 families, comparison is apt with the town of Wythenshawe, England, states Walter H. Blucher, executive director of the American Society of Planning Officials.

Wythenshawe, England's newest planned low-cost housing community, takes its place alongside the widely heralded garden cities of Letchworth and Welwyn. The city council of Manchester, large industrial city which planned, and now owns and operates Wythenshawe, applied to Parliament for permission to include 5,500 acres in the planned program for the satellite-garden-town. Sixty-eight per cent of the desired area is now controlled by Manchester through consent of Parliament.

The English community is planned to provide homes for an ultimate population of 100,000 to 125,000 persons, with a maximum density of 12 families to the acre. (In the central belt of Manchester, families average 60 to the acre, a density by no means a "peak" for equivalent sections in either English or American large cities.) For the present population of approximately 32,000, there are now about seven thousand corporation houses with approximately a thousand under construction. Houses can be privately constructed, subject to regulations laid down by the city of Manchester.

The English city differs from the American in that the latter does not contemplate, at least for the present, the establishment of local industries. In existence for seven years, Wythenshawe has found that, with most of the industries located in Manchester proper, transportation costs are a noticeable burden to low-income workers, and is now encouraging private enterprise to establish industries within its own boundaries.

FROM FIELD AND OFFICE

Working problems and time-saving methods . . . Edited by Charles S. Hill

Gas Testing Car

Los Angeles makes regular gas surveys of all parts of the sewer system. Recently a light motor truck has been fitted up with equipment for speedily sampling and testing samples of air taken from manholes. Where dangerous conditions are suspected the tests are made every two or three months; otherwise about once every two years. A two-man crew (an operator and a driver) tests about 70 manholes an hour.

It is unnecessary to remove the manhole covers; the vehicle is stopped either alongside or over the manhole to be tested and a copper sampling tube is passed down through the side doors or through an opening in the bottom of the truck and on through the lifter opening in the manhole cover. The test equipment used is a commercial indicator of combustible gas, but instead of the usual hand-operated bulb, which requires ten aspirations per manhole to bring up the necessary gas sample, a connection from the truck motor brings suction to the sampling tube and thus the operator has only to turn an air valve to bring up the necessary quantity of the suspected atmosphere. A record of each test is made in a log book while the truck is moving to the next manhole.

The special truck was fitted up under the supervision of H. P. Cortelyou, deputy engineer in charge of waste disposal. Lloyd Aldrich is city engineer of Los Angeles.

Gas survey truck searches for explosive gas dangers in Los Angeles sewers.

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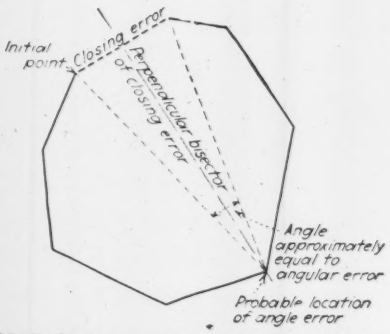
Correcting Closure Error

by GEORGE C. COMMONS

When in making a survey, the last course fails to make an angular closure, due to an error in angles at some transit point, the method illustrated will often serve to locate the error, thus giving one angle to check in the field, instead of repeating the entire survey. The principle of the method is that in plotting the survey according to the field notes, the portion made after the angular error may be pivoted about that point to the amount of the error, so as to make a closure.


Initial point
Closing error
Perpendicular bisector of closing error
Angle approximately equal to angular error
Probable location of angle error

Method of correcting closure in a survey.

To apply this method, the survey is plotted in the order in which it was made, and the closing line is drawn in. A perpendicular is erected at the midpoint of this closing line, and the following tests are applied: (a) If the perpendicular bisector of the closing error passes through or near to an angle point of the survey, and (b) if the angle subtended at this angle point by the closing error approximates the angular error of closure, and (c) if pivoting the latter portion of the survey about this angle point so as to eliminate the closing error is in the direction required to correct the angular error, then it is very probable that the error is at this angle point.

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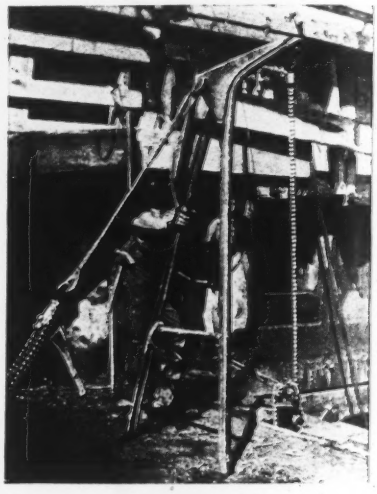
Jack for Stripping Forms

by DANIEL MCFARLAND

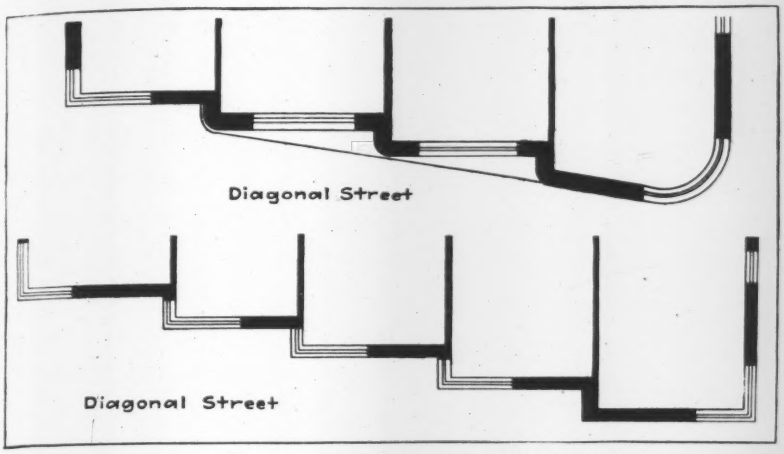
Mason City, Wash.

The concrete at the Grand Coulee Dam is poured in blocks 50x50 ft. and other smaller sizes. The forms used are panels 5 ft. high and 25 ft. long. These are made of 1½-in. lumber backed with 2x6-in. studs and 8x8-in. wales. The two 25-ft. sections are bolted together and act as a unit after the first installation. To raise them, three jacks are used one at each end and one in the center.



Hoists used in stripping and raising form panels.

The jacks, as shown by the illustration, are set with the head slightly out from the vertical position and the chain hoist is tightened up. Then the bolts are released and the form loosened from the concrete. The panel is raised and the chain at the rear of the jack is tightened swinging the panel back in position to be reset. The form rods are put in place and the jacks released. The stripping crew goes to the next block and the carpenter crew comes along later and lines up the forms and puts in the special features.



Two types of sawtooth fronts on a diagonal street.

Sawtooth Building Fronts

by ABRAHAM ABRAMS
New York, N. Y.

Recent apartment buildings on diagonal streets in New York city have increased light and air because of sawtooth fronts. Sawtooth roofs are familiar; set one on edge and a sawtooth wall is had. The accompanying diagram plans are for buildings facing Grand Concourse, a diagonal street. At 1188 Grand Concourse, by use of the sawtooth, the architect avoided any rooms at odd angles and had all the lines parallel or perpendicular. The front rooms have been squared out. Another advantage of this form of construction is that it allows a corner casement window to be used in each of the rooms that form the teeth of the saw thus admitting more light and air. A different condition prevails at 1150 Grand Concourse. There the architect carried the wall parallel to the Concourse but recessed the windows to gain the advantage of a sawtooth. This building also has the now popular round-corner windows.

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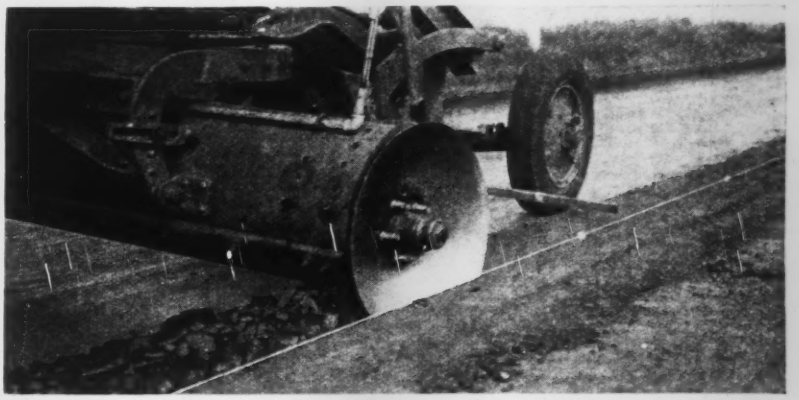
Edge Cutter for Asphalt Roads

by ALLEN P. CHILD
Kansas City, Mo.

To do away with the irregular border line so often seen at the edges of pavements the cutter illustrated was developed by J. C. Adams, of the California highway department in conjunction with the A. J. Raisch Contracting Co. The device is made from an ordinary automobile axle and hub equipped with roller bearings. To this is fastened a 24-in. diameter farm disk which is bolted to the hub. A shank of the original axle, 20 in. long, serves as a support for the disk and is bolted to the moldboard of the power grader. It is attached and removed from the moldboard in about 15 min.

In use the disk attachment first cuts a true edge along the earth shoulders before the plant-mixed material is spread. To maintain a true cut a chalk line is stretched between points at 400 ft. intervals. When the plant-mix surface is completed and before roadmixing the shoulders the center line is re-run and points set at 400 ft. intervals on tangents and at 50 ft. on curves. So as to form a true border for the oil-mix shoulders the surface edge is then cut.



Disk attachable to grader moldboard does away with irregular edges on plant-mix road surfaces.

Simple Specific Gravity Test

by JAMES E. BASS
U. S. Engineer Office, Miami Beach, Fla.

For determining the specific gravity of solids of density greater than one, the following simple method is suggested:

The necessary apparatus includes one platform scale; one vessel sufficiently large to contain the object to be tested, when immersed and clear of the sides and bottom of the vessel, and a short piece of strong fine wire.

Weigh the object W. Place the vessel containing the water on the scales and weight W_1. Leaving the vessel on the scales suspend the object therein by the wire from some stationary overhead support and again take the weight of the Vessel W_2.

The specific gravity is then $\frac{W}{W_2 - W_1}$

The method is useful in the laboratory, particularly for large specimens. In the field it has been found especially useful in the accurate determination of the weight of concrete, using standard compression-test cylinders as specimens. On one job the average difference in the designed weight of concrete and the actual weight, as determined by this test from a number of cylinders, was .02 lb. per cu. yd. of concrete. This method of determining the weight of concrete is much more accurate and is less trouble and expense than the often specified method of casting large and bulky specimens in testing the specific gravity of concrete which is to be used for lift and bascule, etc., bridge counterweights.

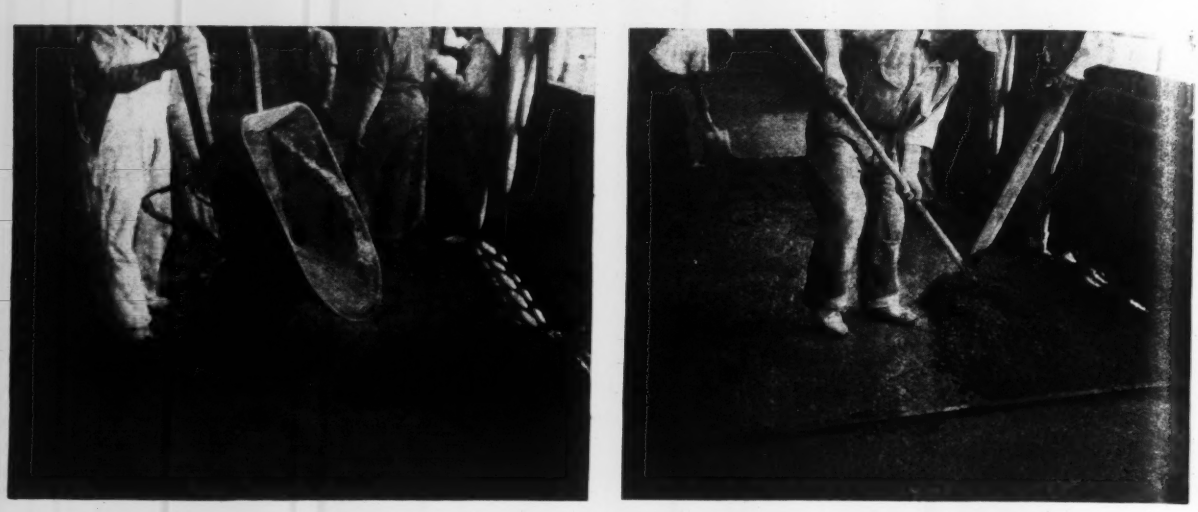


FIG. I. START OF A PERFECT CONCRETE FLOOR FINISH. MATERIAL IS RAKED TO DESIRED THICKNESS

Finishing a Concrete Floor

Buffalo contractor uses high silica aggregate and rotary screed-tamper to obtain a tough and durable surface for factory floors

THE APPLICATION of a finish coat to concrete floors to obtain a tough and durable wearing surface has been developed to a high degree of perfection by the John W. Cowper Co., building contractor of Buffalo, N. Y. The top finish course requires no special material except a high silica aggregate, and uniform results are secured through careful control of construction operations that include the use of a rotary combination screed and tamper. Laying of this type of finish on floors of a six-story factory building now under construction by the Cowper Company for Trico Products Corp. in Buffalo is typical of the process as developed by the contractor.

Floor preparation

The building is of steel frame construction with gravel aggregate concrete floor slabs left 1 in. below finished floor grade. Special care is taken in striking off the top of the structural slab to leave the surface fairly level. Just before the slab concrete reaches its final set the surface is brushed with a steel broom to provide a good bond for the finish.

Application of the finish course is delayed until the walls are closed in and most of the mechanical work is installed, thereby protecting the finish from weather and from disturbance by the various mechanical tradesmen. The Cowper company believes in "good housekeeping" on its job as a safety precaution and as an item in expediting the work. The job is kept clean and orderly; trash is not allowed to accumulate. Consequently, when the time comes for applying the finish floor course there is but little cleaning up to do; a mere sweeping is all that is required.

Experience has shown that soaking of the slab for 24 hr. previous to placing of the top course is desirable to prevent absorption of moisture from the finish concrete before full hydration has taken place. The two courses then, as a foreman expressed it, dry out together. Just before the finish is to be placed the slab surface is thoroughly washed down with hose and broom and then is flushed with a thin cement grout. The slab is now ready for the top course.

The surface material consists of almost pure silica aggregate, mechanically graded and proportioned to the contractor's specification at its source in Ohio. Sand, gravel up to ¾-in. maximum size and a small amount of silica grit make up the aggregate. At the job it is mixed in a 10-S mixer in the proportions of three parts of aggregate to one of portland cement. The mixture as it comes from the mixer looks harsh and dry. Control of water in the mix is by rule of thumb; the mixed product should contain just enough water to make the particles stick together when squeezed in the hand. Failure to stick means too little water; if moisture can be squeezed out the mix is too wet. An experienced mixer crew turns out a remarkably uniform product despite lack of mechanical control of the water content.

In this particular building the mixer is set on the first floor near a double-cage tubular steel elevator located in a small light court. The aggregate is hauled from railroad siding to the job by truck, and is charged into the mixer skip by

Fig. 2. Second and third stages of laying the finish course. After spreading, the dry concrete is tamped by hand and then screeded with a mechanical rotary finisher that brings the mortar to the surface and makes a tight, smooth seal.

wheelbarrows. A two-sack batch is mixed at one time. From the mixer the concrete is handled in pneumatic-tired wheelbarrows, hoisted up the elevator and wheeled to place by members of the placing crew.

A 30-ft. strip of floor slab is divided into blocks 14 ft. wide by 1-in. screed boards, carefully set to grade by building up underneath with finish concrete if necessary. Wheelbarrow loads of finish material are dumped into piles over a 14x30-ft. block. The fresh concrete is immediately spread with shovels and rakes, and here again an experienced crew does a remarkable job in spreading to almost exact grade. As the mix is spread it is also tamped by hand tampers consisting of a heavy bar screen fastened to a long wooden handle. The bars, while set close together, are still far enough apart to prevent splashing of the mortar. After a thorough tamping of the material, a 14-ft. screed is passed over the surface, riding on the transverse screed strips which are pulled and their slots filled in as soon as possible.

Mechanical screed

The first finishing of the top course is by a 300-lb. rotary mechanical screed, an adaptation of the ordinary electric terrazzo floor grinder. A 30-in. smooth iron disk replaces the grinder unit. Two free-swinging hammers on the side of the apparatus ride on a corrugated rib welded to the top of the disk plate. As the plate revolves the hammers are kicked up by the corrugations and, falling by their own weight, produce a tamping and vibrating effect.

Up to the time the mechanical screed is brought into use the finish retains its coarse and harsh characteristics, not affected by the hand tamping. However, the polishing and tamping of the rapidly revolving mechanical finisher quickly brings the mortar to the top and produces a smooth, tight surface. In the hands of a clever operator the machine irons out all imperfections in the surface, digs under the high places, fills in the low spots and moves around under its own power with but little pushing and pulling required by the operator.

After the finishing machine is through the floor looks perfect, but a final touch is given the surface with steel floats by hand. The mechanical finisher leaves the finish hard enough to walk upon without a trace of footprints, so the hand finishers need not work from bridges and use only knee-boards. The newly-laid finish is kept wet for three days.

A laying crew of two wheelers, two shovelers, two rakers, two tampers and two operators with the rotary machines is turning out 9,000 sq. ft. of floor finish every 8-hr. shift. An additional crew, of course, is required at the mixer.

The durability of this type of floor finish is demonstrated by an installation made last year in an older section of this same factory used as a foundry. Here heavy pans of slag are continually being dragged across the floor from furnaces to the slag pile, and there isn't a mark on the floor today.

The Trico Products Corp. building was designed by Warwick R. Jewell, consulting engineer of Buffalo. B. W. Keeler is superintendent on the job for the John W. Cowper Co.

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Many Cities Found To Be Over-Zoned

THE EXTENT to which a zoning ordinance actually protects a community against undesirable intrusion is a question bothering a number of American cities, according to the American Society of Planning Officials.

Most of the urban population of the United States resides in zoned communities, which are now analyzing themselves to determine the value of their zoning ordinances. Zoning is generally regarded as an effective influence in protecting residential and commercial areas and stabilizing land values, and in making cities more desirable places than they would be if subject to no such control.

Planners believe that a great many cities are over-zoned for commercial and industrial purposes. Its zoning in these classifications, however, actually prevents it from being used for any other purpose.

As an example, the City Plan Commission of Chicago, in a recent report, found that in 1923 when the city was zoned, 49 sq. mi. were allocated for manufacturing purposes, but that actually 26 sq. mi. were so used less than one per cent.

Notes on Sewage Disposal

A monthly summary of current developments conducted by Willem Rudolfs

TOXICITY OF SEWAGE—The effect of sewage on fish life is generally considered to be caused by lack of oxygen in the water or due to organic matter which competes with fish for the oxygen available. Studies made in the river Tees in England (Water Pollution Research *Paper* No. 6, 1937) show that fresh undiluted sewage contains unstable substances which are directly toxic to fish. Sewage one or two days old which was constantly stirred in an open tank was even more toxic than fresh sewage, possibly owing to the production of additional poisonous substances. It was also shown that the B.O.D. is directly proportional to the strength of the sewage, so that the higher the B.O.D. of the fresh sewage the greater the degree of toxicity. River water with a plentiful supply of oxygen will absorb moderate quantities of sewage without being harmful to fish, provided the sewage is not septic and does not contain sulfides. Where sludge bank formations occur, however, the anaerobic conditions in the sludge cause sulfide formation which may affect the food of the fish as well as the fish directly.

AERATION SYSTEMS—Comparative studies made at Manchester, England, showing the power required and purification effected with different aeration systems indicate that certain types of mechanical aeration produce better results than direct aeration for equal power consumption. Stating it differently, approximately equal purification can be accomplished at lower cost with mechanical aeration. The summarized yearly results from the *Annual Report* of the Manchester Rivers Department are as follows:

	Aver. hp. per m.g.	*Hours aeration*	*% B.O.D. reduction*
Bio-aeration	45.80	18.3	91.1
Simplex aeration	28.55	13.4	92.7
Diffused air	34.80	10.6	93.1

It is evident from the data in the second column that the capacity of the aeration units must be greater for mechanical devices than for diffused air. The effluents contained in all cases 0.9 p.p.m. nitrates, indicating that no excessive nitrification took place and no unnecessary over-aeration was practiced.

ICE AND BACTERIA — Statements that water tends to purify itself upon freezing and that even ice produced from highly polluted waters is likely to be innocuous are generalities which may approach the truth but must be accepted with an understanding of the mechanism involved. The so-called purification taking place during freezing is not necessarily due to the death of the organisms, although large numbers may die. Bacterial removal from ice is mechanical and due to the formation of a sludge in which organisms are precipitated. If freezing takes place very rapidly this sludge may be entrapped in the ice along with the bacteria, and these organisms remain viable. All this is reported by Beard (*Jour.* A.W.W.A. Feb. 1938) who states that even should the sludge be precipitated, small twigs, leaves or other debris frozen in the ice retained large numbers of viable typhoid organisms. When the ice melts the water again became infected.

SLUDGE BULKING—In activated sludge treatment conditions may develop which lead to sludge floating and bulking. It has been observed frequently that insufficient available oxygen results in undesirable conditions such as bulking. The amount of air required appears to vary with the organic load, and when sewage contains in addition to the usual constituents large quantities of substances with a high oxygen demand, additional air must be supplied to prevent septicity. Rising of sludge may be due to septicity, but it has been reported that blanket rising of the sludge in the final tanks may be caused by nitrogen set free by the denitrification of the oxidized end products.

Bragstad and Bradney, (paper before the Central States Sewage Works Assoc., Oct. 21, 1937) describing the operation of the activated sludge plant at Sioux Falls where large quantities of packing house waste are received, found that floating occurred whenever the aerator effluent was high in nitrites (sometimes as much as 350 p.p.m.), and that bulking occurred when the dissolved oxygen disappeared. The floating sludge was enmeshed with tiny bubbles of gas. Floating and bulking took place simultaneously only during the transition from one phase to the other. These conditions made it necessary to operate within a narrow range of air supply and maintain from 2 to 3 p.p.m. dissolved oxygen in the first half of the aerator and not more than 0.5 p.p.m. in the latter half to obtain a good effluent without sludge troubles.

SLUDGE IN LAKES—Utilization of lakes for completing purification of partially treated sewage has been practiced for several years on a large scale on the Ruhr River in Germany. Sewage treatment in the district consists principally of sedimentation. During recent years a rapid increase in the pollution load on the stream and lakes has taken place. Prüss (*Ann. Report.* Ruhrverband, 1936) states that in order to increase the purification capacity of the principal lake the height of the dam must be increased to obtain an additional 15,000,000 cu.ft. of water storage. Considerable sludge accumulation has taken place and the lake must be cleaned. Special measures will be enforced to reduce the pollution coming from the treatment plants, and industrial wastes detrimental to the natural purification in the lake will be reduced.

GAS CORROSION—Sewage plant operators having trouble with corrosion of boilers, flues, pipes or other parts of heating systems are given a hint to prevent these troubles by Rawn, Banta and Pomeroy (*Proc.* A.S.C.E. Nov. 1937). Gas burned for water heating was found to cause corrosion of the flues and resulted in the deposition of plugs of iron sulfate in the lower ends of the flues. The use of forced draft to prevent condensation of moisture in the flues eliminated the corrosion.

The Stiffness of Beams

by Robins Fleming
American Bridge Co., New York, N. Y.

Resistance to bending, called stiffness, is dependent upon type of end supports, modulus of elasticity, moment of inertia, span length and load

An inquiry published in the issue Sept. 23, 1937 relative to the stiffness of beams of different materials resulted in a surprising volume of correspondence. The interest and the varied ideas displayed suggested that a review article would be in order. In typical scholarly manner and documented style, Robins Fleming has provided it. —Editor

More than a hundred years ago Thomas Tredgold wrote, "The stiffness of a body is its resistance at a given deflexion." ("A Practical Essay on the Strength of Cast Iron." London, 1822.) Webster defines stiffness as the "Resistance, as of a beam, to bending under stresses under the elastic limit" and adds, "Stiffness is inversely as the deflection." In "Analysis of Continuous Frames by Distributing Fixed End Moments" (*Transactions* Am. Soc. C. E., Vol. 96, 1932) by Hardy Cross is the definition, "Stiffness, as herein used, is the moment at one end of a member (which is on unyielding supports at both ends) necessary to produce unit rotation of that end when the other end is fixed." Generally stiffness is used as a relative term. It is the reciprocal of flexibility.

The familiar formula for deflection of beams is,

$$d = \frac{K W l^3}{E I}$$

in which d = deflection (in.)
l = length of beam (in.)
W = total load (lb.)
E = modulus of elasticity
I = moment of inertia
K = a constant, depending on the type of load and on the manner of support

Since stiffness is inversely as the deflection, it consequently is directly proportional to E and I and inversely proportional to the load and the cube of the length. Although the weight of a beam is usually small compared with the load, the weight may be added to a load uniformly distributed. If the load is concentrated at the center, one-half the weight may be added. For accuracy of calculation in other cases of loading, it may be more convenient to determine the deflection due to the weight of the beam separately. In theory, the deflection of the neutral axis is used; in practice deflection is measured on the top or bottom of the beam.

Rankine in his classic "Applied Mechanics" states "each piece of a structure should be of such dimensions that its alteration of figure under the greatest load applied to it should not exceed certain limits. This property is called stiffness, and is so connected with strength that it is necessary to consider them together." Rankine entitled a chapter "Strength and Stiffness." The stiffness of a beam consists in its ability to resist bending; the strength of a beam consists in its ability to resist breaking.

Relation to strength

It is important to note that stiffness does not vary in the same ratio as strength. The accompanying table taken from Merriman's "Mechanics of Materials," shows the relationship very nicely. The relative increase of stiffness ratio over strength ratio is quite marked in beams with fixed ends.

It may be noted here, "A beam of uniform strength will not be so stiff as a corresponding beam of uniform section sufficient to carry safely the maximum bending moment, for the stiffness arising from an additional material in the second case is lost" (Greene, "Structural Materials"). For beams of uniform strength, if the depth is constant, the moment of inertia, I, is variable, and the maximum deflections are greater than those given in the table. For a simple beam of uniform strength and constant depth loaded at the middle, the constant of the maximum deflection is 1/32 instead of 1/48; if uniformly loaded it is 1/64 instead of 5/384. Therefore, the stiffness with load at the middle is 2/3 of what it would be if the cross section were the same throughout; with load uniformly distributed, the stiffness is 5/6 of what it would be for the same cross section throughout. The ratios of stiffness for cantilever beams of uniform strength and constant depth compared with those of uniform cross section are 5/9 for a load at the free end and 1/3 for a load uniformly distributed. A plate girder with built-up flanges is approximately a beam of uniform strength.

Relation to stress

Stiffness is sometimes convenient in terms of stress. For beams so compared, the ratios of "relative stiffness" in the last column of the table are 1, $1\frac{1}{3}$, 4, 3.2, 6.56, 7.71, 8 and $10\frac{2}{3}$ respectively, instead of those given.

A chart by Odd Albert (*American Architect*, January, 1936) gives deflections in terms of maximum fiber stress and depth of beam. With the same fiber stress and same length, the deflection, and hence the stiffness, is always the same for a symmetrical section regardless of its shape. This is seen by substituting for I its value in $M = S I/\frac{1}{2}h$ and making the load a factor of M. Thus $I = \frac{Mh}{2S}$ and, for a simple beam uniformly loaded, $W = \frac{8M}{l}$. Substituting these values in $d = \frac{5}{384}\,\frac{Wl^3}{EI}$ the equation reduces to $d = \frac{5}{24}\,\frac{l^2 S}{E h}$ or for the same values of l, S and h the deflection is constant, whether the section be a thin rectangle, a square or a rolled section, provided the section is symmetrical.

The strength of a beam is measured by the load that it can carry with an assigned unit stress. The stiffness of a beam is indicated

COMPARISON OF BEAMS OF UNIFORM CROSS-SECTION

	Maximum Moment	Maximum Deflection	Relative Strength	Relative Stiffness
Cantilever, load at end	Wl	$\frac{1}{3}\frac{Wl^3}{EI}$	1	1
Cantilever, uniform load	$\frac{1}{2}Wl$	$\frac{1}{8}\frac{Wl^3}{EI}$	2	$2\frac{2}{3}$
Simple beam, load at middle	$\frac{1}{4}Wl$	$\frac{1/48\ Wl^2}{EI}$	4	16
Simple beam, uniform load	$\frac{1}{8}Wl$	$\frac{5/384\ Wl^2}{EI}$	8	$25\frac{3}{5}$
Beam fixed at one end, supported at other end, load near middle	0.192 Wl	$\frac{0.0098\ Wl^2}{EI}$	5.2	30.7
Beam fixed at one end, supported at other end, uniform load	$\frac{1}{8}Wl$	$\frac{0.0054\ Wl^2}{EI}$	8	62
Beam fixed at both ends, load at middle	$\frac{1}{8}Wl$	$\frac{1/192\ Wl^2}{EI}$	8	64
Beam fixed at both ends, uniform load	1/12 Wl	$\frac{1/384\ Wl^3}{EI}$	12	128

by the load that it can carry with a given deflection. If two beams of the same length and material are loaded and supported in the same manner, the ratio of the stiffness of one beam to that of the other is equal to the ratio of their moments of inertia. The ratio of the strength of the one to that of the other is equal to the ratio of their section moduli.

Practical limits

Limitations are often placed on the ratio of the depth of beams to their length. Thus, Ketchum in his "Specifications for Steel Frame Buildings" calls for the depth of rolled beams in floors to be not less than 1/20 of the span and for beams and channels used as roof purlins to be not less than 1/40 of the span.

For beams subject to moving loads, the deflection should be limited to an amount that will not set up dangerous vibrations. In a paper, "The Design of Structural Steel Supports for Turbo-Generators," by Edward H. Cameron (*Transactions*, Am. Soc. C. E., Vol. 86, 1923) the maximum allowable deflection is given as 0.02 in. In the discussion following the paper one speaker said that in the design of about forty foundations in which he had been interested the deflection of beams in the table-top type had been kept less than 0.006 in. To reach this degree of stiffness exceedingly low unit stresses would have to be used. The allowable deflection for beams and supports in elevator hoistway construction as given in the new building code of the City of New York varies from 1/1333 to 1/2000 of the span, dependent upon the speed of the car and whether direct or alternating current is used.

Shafting should be stiff. Lanza in his "Applied Mechanics," a widely-used book forty years ago—says that we ought not merely to consider the resistance due to twisting, but also the deflection under the transverse load of the belt pulls, weights of pulleys and the like. "This deflection should not be allowed to exceed 1/100 of an inch per foot of length." Kimball and Barr, "Elements of Machine Design," Third Edition, 1935, wrote, "The lateral deflection of the shaft should not exceed 1/100 in. per foot of length to insure proper contact at the bearings."

The stiffness of a beam is dependent upon the material of which it is composed as well as upon its dimensions and manner of loading. And since stiffness rather than strength is often the governing factor in design, some materials are better than others for a given type of service. For example, the modulus of elasticity E, of wood is relatively low, so that the stiffness of wood beams is also low. The low degree of stiffness of timber makes it especially adapted for railway ties. It should be kept in mind that comparisons between beams of different materials may be misleading if stresses exceed the elastic limit.

Concrete beams are very stiff, and it is seldom their deflection is of concern. Various formulas have been proposed for computing the deflection of reinforced concrete beams but the problem is complicated. "The deflection in reinforced concrete depends primarily upon the ratio of the depth of the beam or slab to the span. It also depends upon the percentage of tension and compression reinforcement, and in T beams, upon the width of the flange." (Taylor, Thompson and Smulski, "Concrete, Plain and Reinforced," Vol. 1). The uncertainties, according to Cross and Morgan, in their "Continuous Frames of Reinforced Concrete," are (a) The steel stress depends on the amount of cracking; (b) The steel stress is affected by bond stress in the cracked area; (c) Both these values affect the c (the c of the flexure formula) value of steel, as does the uncertainty of E for concrete; (d) The E of the concrete varies with time. "Consequently," the authors continue, "the deflection of the simplest concrete beam is difficult to predict."

Shearing deflection

In the foregoing the stiffness considered has been due to the deflection from flexure or "pure bending." An additional deflection results from the shearing stress caused by the load. This will, of course, tend to lessen the stiffness. Swain in his "Strength of Materials," writes "The deflection due to shear is almost always neglected. It is, however, not always insignificant." The subject involves many difficulties. The treatment found in textbooks on "Strength of Materials" is sufficient for practical purposes. The reader who wishes to pursue the study in greater detail is referred to an article by Professor S. E. Slocum: "A General Formula for the Shearing Deflection of Beams of Arbitrary Cross-Section, either Variable or Constant." (*Journal of the Franklin Institute*, Vol. CLXXI, pp. 365-389, April 1911).

For steel beams as ordinarily used, the deflection from shear seldom exceeds 2 per cent of that from pure bending. In an investigation of a wide range of beams the writer found that when the length was greater than ten times the depth the deflection from shear was rarely 5 per cent of that from bending and never exceeded 6 per cent. The cases that should be investigated are short deep beams heavily loaded and those in which severe limits are assigned to deflection.

Addenda

The foregoing was written before the problem of the relative stiffness of a particular cast-iron and a steel beam was presented in the issue of September 23, 1937. In view of the extended discussion called forth by

the problem, the following is offered as supplementary to that previously written.

Withey and Aston in rewriting Johnson's "Materials of Construction" say, "The flexure formula $M = f\frac{I}{c}$ does not hold for beams of materials when E_c does not equal E_t nor for beams of materials stressed beyond the elastic limit." (Fifth Edition, 1919.) In the cast-iron beam of the problem E_c does not equal E_t and stresses are beyond the elastic limit. Of those who took part in the discussion only R. Grossman (issue of December 2), and A. W. Fischer (issue of December 23) seem to have considered both of these facts.

Mr. Grossman finds the neutral axis of the cast-iron beam to be 0.325 in. from the bottom side. As seen at a glance, his arithmetic is in error: $\frac{.5 \times 5390}{8850} = 0.3045$ in. and not 0.325 in. In like manner: $\frac{.5 \times 3460}{8850} = 0.1955$ in. and not 0.175 in. With this location of the neutral axis, the moment of intertia, I, is 0.0588 in. and not .0527 in. For the steel beam, I is 0.0208 in.. as used by Mr. Grossman. For a load of 50 lb. in the center (neglecting dead load) the deflection of the cast-iron beam is .0588 in. (not .0527 in.) and of the steel beam is .0276 in. Incidentally, the diagram of Mr. Grossman is drawn incorrectly. The triangles above and below the neutral axis should be of equal area. The bases of his triangles should be exchanged one for the other. The maximum unit fiber stresses in the cast-iron beam from $f = \frac{Mc}{I}$ are $f = 3{,}023$ lb. per sq. in. for compression and $f = 2{,}049$ lb. per sq. in. for tension. If a load of 500 lbs. were permissible these values should be multiplied by 10. "There is no formula for such a case, but it is certain that the usual formula will be quite incorrect." (Swain, "Strength of Materials.")

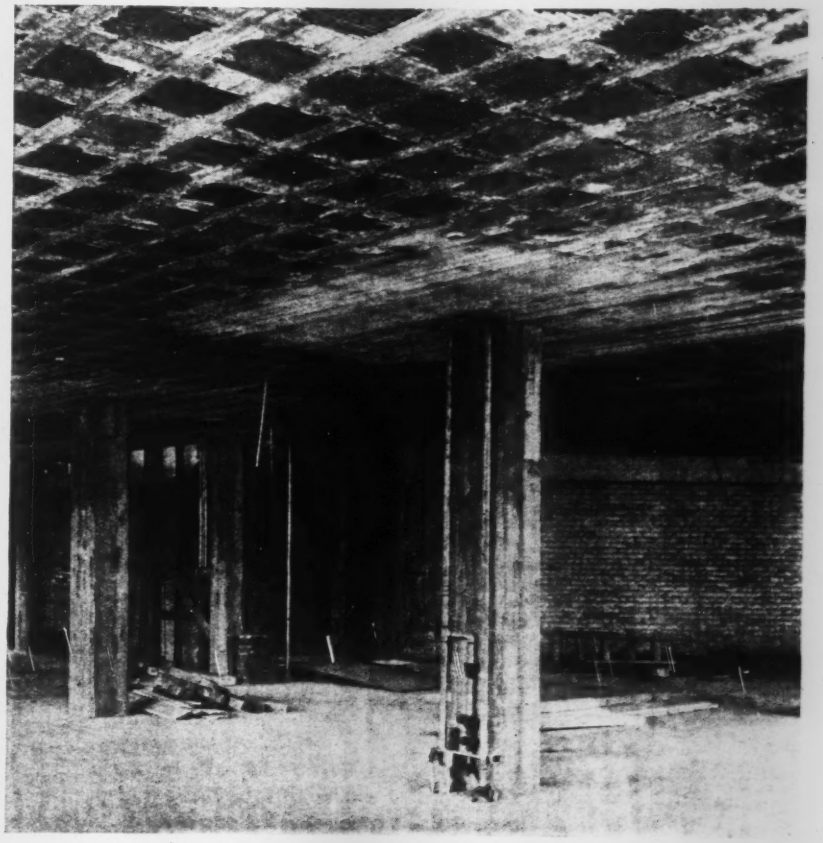
Mr. Fischer (issue of December 23) notes that the neutral axis of this particular cast-iron beam is above the center of the section at midspan and below the center at the ends. Mr. Fischer wisely concludes, "For higher stresses actual tests of the two beams must be used to answer the question."

Flat Slab of Tile and Concrete

Solid slab used in negative moment areas around columns and tile filler elsewhere

THE 7-story addition to the Railway Exchange Building in Denver records a new development in the special type of flat slab built with embedded steel column heads and without capitals or drop panels. This type of construction is known as the "smooth ceilings system" (*ENR*, Oct. 18, 1934, p. 490). The new development consists in the use of a solid concrete slab around the columns in the areas of maximum negative moment as heretofore, but with 6x12x12-in. clay tile fillers spaced about 16 in. on centers both ways in the middle strip areas. This type of flat slab was developed by Walter H. Wheeler, consulting engineer, Minneapolis. In the Denver building, according to Mr. Wheeler, slab reinforcement was proportioned to permit one reinforcing bar per joist, alternating the bent and straight bars, to simplify the placing of the slab steel.

A considerable part of the building is two bays wide, the front bay being about 26 ft. and the rear bay about 20 ft. The column spacing lengthwise of the building is 16½ ft. except for 20 ft. bays at either end. The rough concrete floor slabs above the first floor are 9¼ in. thick, designed for a live load of 60 lb. plus superimposed dead load of 40 lb. per sq. ft. The dead load of the slab is estimated at 90 lb. per sq. ft. or 24 lb. less than a



Flat slab ceiling of tile filler type except for the use of solid slabs around the columns as used in the new Denver Railway Exchange Building

solid concrete slab of the same thickness. In addition to this weight saving the tile fillers permitted a better distribution of the dead load of the slab, according to Mr. Wheeler so that the moment factors for the column strips are reduced about 6½ per cent below factors that would be used for a solid slab having a weight of 90 lb. per sq.ft. An additional advantage of the new design is that the scored tile provides a good bond for the plaster ceilings.

The building was designed in accordance with the American Concrete Institute code, and slab moments were adjusted to meet the condition of irregular panels and two bay width.

Under a test load of 135 lb. per sq.ft. applied over the full area of one of the front panels on the third floor, the center deflection was less than ⅛ in. or about 1/2100th of the span; the immediate recovery when the load was removed was 100 per cent. The architects of the building were W.E.&A.A. Fisher of Denver and the F. J. Kirchhof Construction Co. was the contractor.

Erosion and Conservation In the West

Some observations in Arizona and New Mexico on highway stream construction and Conchas Dam

IN ATTEMPTING TO TRANSCRIBE into paragraphs a week's supply of mental notes on engineering developments, seen and heard, one operates under difficulties at the Grand Canyon. Watching the mists rise and dissipate and the reflected colors of the stratified shales, sandstones, and limestones shade off to black granite in the river gorge provides an inspiring setting without question. But, so far as man-made engineering structures are concerned, the inspiration has reverse English on it. Breadth, height, and age are measured in figures so large that our nerve in describing such structures as the Grand Coulee Dam, the Empire State Building or the Golden Gate Bridge with superlatives is painfully apparent.

Still, after obeisance is paid to a certain spiritual value in its beauty and an educational lesson in its rock formations, the Grand Canyon deserves no more. It does not promote safety or impound water or provide transportation as even our smallest and most prosaic structures do. It is just something to look at and to remember.

The subject of erosion is perhaps an avenue of transition from the Grand Canyon to some interesting practices of the New Mexico highway department. At Santa Fe, every bridge and culvert is designed against erosion as much as it is designed against stress. Arroyos that parallel highways are particularly troublesome. Discharge from culverts gradually eats the bank of the arroyo back to the highway unless the culvert is carried beyond the end of the fill. How far should it be carried? Arbitrarily the figure has been set up as equal to the depth of the arroyo. Then when the bank caves back to the culvert discharge, where it invariably remains as a vertical cliff, a line from the bottom of the arroyo to the road edge is on a 1:1 slope.

Sometimes the arroyo is too close originally for such low-cost treatment. The usual procedure then is to pave a chute to the bottom of the arroyo, again on a 1:1 slope.

New Mexico is making extensive and economically effective use of multiple-box culverts to cross its wide dry channels. In some cases as many as fifteen 10 x 12-ft. boxes have been used. Double walls separated by a premolded asphalt filler are used every third or fourth box. Both roadway and channel slabs are continuous over the supports.

Revetments and training dikes are used widely to bring the thread of the stream between bridge abutments and keep it there. All Mississippi River theories apply, but the construction work can be done in the dry, in contrast to the Mississippi "wet process."

So far this year a reasonably dry riverbed has obtained at Conchas Dam, a $12,000,000 irrigation and flood control project being built by the Corps of Engineers on the South Canadian River 75 mi. northwest of Tucumcari, N. M. In contrast, the third greatest flood on record flowed through and over the work last June; the volume of water passing the dam site in 4 days equaled the gross annual yield of 212,000 acre-ft. estimated from a 32-yr. hydrograph. By next year the reservoir will be ready to prevent such waste of water.

A visitor to this isolated project views it first from a distant mesa as a small city of flat-roofed buildings on a treeless plain, its squatness broken only by an elevated water tank. Closer inspection dispels this suspicion of monotony, for the settlement is unique as a construction camp, and more attractive than many a town with a boastful chamber of commerce. About two-thirds of the buildings are of adobe, the remainder of local stone. In the adobe structures, the gray of the mud is contrasted with orange-painted timber window sills and lintels. Light-colored mortar accentuates the stones in the more permanent houses. Porch and roof coping details lend further assurance that definite architectural thought was used on the buildings.

Two kinds of dam building—earth and concrete—are being carried on 24 hours a day. The two miles of earth dikes, rising to maximum 90-ft. height, are the product of 1,350 WPA workers under army engineer supervision. The 235-ft.-high concrete dam across the river canyon is a contract operation by Bent Brothers, Inc., and Griffith Co. of Los Angeles.

The concrete dam is unique in that it is being built in a location where the foundation rocks are upside down, that is, the best rock is on top. But the base rock, an artesian sandstone, is adequate if far from perfect. The difficulty is presented by a 90-ft. stratum of shale over the base rock which weathers and slides when exposed on the abutments. Ingenious construction methods, to be described in a future article, are being used to hold this shale until the dam abutments can enclose it.

Grand Canyon, March 14, 1938. W.G.B.

Practical Pointers on Centrifugal Pumps

Considerations affecting the application and selection of centrifugal pumps for handling sewage and sludge

Various types of centrifugal pumps are available for use in sewage treatment plants. Some of the essentials to be considered in selecting a pump for this specialized service are set forth in the following abstract of a paper presented recently before the Sanitary Group of the A.S.M.E., by M. M. Klosson, chief engineer of Buffalo Pumps, Inc. —EDITOR.

CENTRIFUGAL PUMPS used for handling sewage may be classified as single suction non-clogging types of horizontal, vertical, sump or automatic self-priming pumps. While there is practically no difference in the internal construction of any of these pumps, there may be variations in external mountings to suit particular location requirements. In general, sewage pumps are arranged for automatic operation and this requires great care in making installation so that positive submergence or priming is provided. In all cases where the liquid in the wet well is below the elevation of the pump, it is necessary to supply a vent line from the discharge volute of the pump back to the wet well to prevent air binding troubles.

A study of about 120 installations showed that sewage pumps operate at relatively low pressure, low speed and low velocities. At sewage treatment plants the required pressure is generally less than 15 lb., the speed rarely over 1,150 r.p.m., the average inlet velocity is about 9 ft. per sec. and the average outlet velocity is about 11 ft. per sec.

The importance of reliability of operation cannot be over-emphasized. Interruption of service, even for a short time, may cause serious backing of sewers or flooding of plants. Therefore the usually accepted factor of safety used in the design of standard centrifugal pumps is not considered ample for sewage pumps. Experience indicates that it is necessary to make casing wall thickness substantially heavier than that used for pumps operating on clear liquid service, to use larger bearings, to employ a deeper stuffing box, and otherwise make the pumps more rugged.

Special consideration must also be given to the impeller and the pump casing to avoid clogging. The impeller must be made extra wide and should have not less than two and generally not more than four vanes, the number being dependent on the size of the pump and size of solids handled. The inlet portion of the vanes should also be well-rounded to offer the least resistance to flow.

Since pumps are available with open, semi-open and enclosed impeller construction, the question arises as to which construction will give the most reliable and economical results. If all other pump proportions are equal, the pump fitted with enclosed impeller should have a decided advantage. In this type of construction the internal close running clearances are reduced to a minimum in order to lessen wear, and practically the only point where wear takes place is at the clearance ring joint between the suction and discharge chamber. This joint is usually provided with an inexpensive easily replaced clearance ring.

These important features do not exist in a pump using open or semi-open impeller construction. Both sides of an open impeller must form a close running clearance between the sides of the pump casing or wearing plates and because the wear on the impeller and stationary walls is quite rapid, there is a rapid reduction of pump efficiency during the first few weeks of operation. In order to maintain initial efficiency the impeller and the casing or wearing plates must be renewed frequently, at comparatively high cost.

When selecting pumping equipment one of the first questions to be answered concerns the size of solids

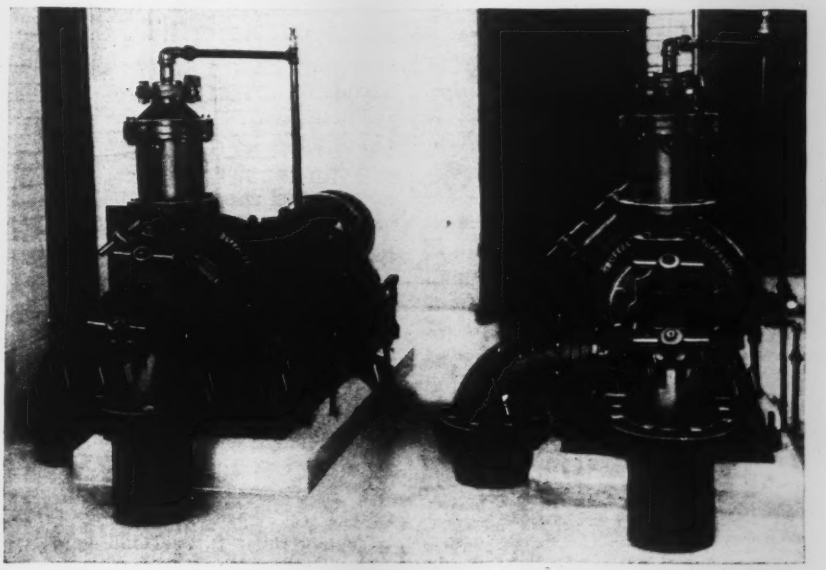


Fig. 1. Horizontal self-priming type of lift pumps arranged for automatic priming, starting and stopping.

the pump should be able to handle. This depends on the spacing of the bar screen at the plant intake, and since the efficiency of plant operation is affected by coarse solids, it is desirable to provide screens with spacing as narrow as possible. It is the spacing of these bar screens which, to a great extent, establishes the smallest practical passage to be provided through the impeller and the pump casing. In general, the smallest capacity pump that should be used is a 3 in. size which will pass solids of at least 2 in. diameter. A pump of this size can be used when the bar screens spacing is not greater than 1 in. A pump capable of passing 3 in. solids will assure satisfactory operation where the bar screens have been spaced on 2 in. centers.

While pumps capable of handling smaller than 2 in. solids are not practical, there are also definite hydraulic and mechanical limitations if the pumps are required to handle excessively large solids. The reason for this is that the size of maximum solids a pump is required to handle determines minimum passages through the impeller and the pump casing and thereby imposes definite limitations upon the design. These limitations have a direct relation to the pump efficiency. If the impeller passages are too narrow, the reliability of operation is detrimentally affected. If the passages through the impeller are excessively large, the pump efficiency is reduced and to a large extent mechanical operation is less dependable.

Pump characteristics

A suitable pump characteristic cannot be properly determined without taking into consideration the flow characteristics at the treatment plant. Generally, the rate of flow in the sewer discharging into the pump station is variable, changing from hour to hour. Pumping schedules are usually arranged so that the rate of pumping closely approximates the rate of inflow. And maximum efficiency is secured in the treatment plant if the flow from the pumping station is steady and reasonably free from surges and irregularities. To meet such conditions it is necessary for the pumping units to provide variable capacity.

For small installations this is frequently effected by the use of one or more variable speed pumps in conjunction with a constant speed pump. This requires proper choice of pump characteristics to maintain high pump efficiency over a wide capacity range. In larger installations high overall efficiency is usually obtained by the use of constant and variable capacity pumps. In such case the constant capacity pumps carry the major proportion of the load and the variable units carry the variation in flow.

Under these imposed conditions, the question arises whether a steep, intermediate or a flat head capacity characteristic is best suited. In general, a flat head capacity characteristic will prove most efficient. A steep head capacity characteristic is least efficient if considered over a wide capacity range, and will give the least variation in capacity due to change in pressure. In actual practice, analysis indicates that the head capacity characteristic should not be too flat or too steep. Considerable risk is involved if a relatively flat head capacity characteristic, having very little rise in pressure from rated capacity to shutoff, is used where the total head is not accurately determined. Pumps with this characteristic are not suitable for operation in parallel with other pumps—they do not give sufficient speed variation, and therefore are not practical for variable speed motor application.

A pump with steep head capacity characteristic overcomes these objections but it consumes more power at partial capacity. While it gives the frequently desired greater and more flexible speed range, too wide a speed range is objectionable because the motor efficiency is reduced about 1 per cent for each 1 per cent speed reduction. Experience indicates that for highest efficiency and most dependable operation a pump having head capacity not too steep or too flat should be used. Such a pump can be used in combination with constant or variable speed and, where necessary, will operate in parallel with other constant speed pumps. It must be borne in mind that when pumps are required to operate in parallel, the head capacity characteristic should be constantly rising from rated capacity to shutoff delivery, and all the pumps in the system should produce approximately the same shutoff head. Otherwise the pump capable of developing highest pressure will assume the load and may cut out other pumps of the system.

Probably the most valuable engineering contribution in pump design made during the last half decade is the development of horizontal self-priming pump. A number of these pumps are in satisfactory operation and they can be considered past the experimental stage. These units are entirely self-contained, simple in construction, and have comparatively few working parts.

Centrifugal sludge pumps

Sludge pumps form an important part of the equipment of sewage treatment plants. Usually reciprocating pumps are used for this purpose but in many cases, special centrifugal pumps may be employed. No attempt should be made to use standard sewage pumps for this purpose.

For handling raw sludge containing a large percentage of rags and other solids the pump must include provisions for breaking up the solids without clogging. Except for the high percentage of solids carried in suspension, the raw sludge is not difficult to handle with a centrifugal pump. The digested sludge, however, carries high percentage of entrained gases and these are likely to be liberated when sludge is put into motion and thereby cause priming difficulties. Due to abnormal gas content and possible clogging difficulties it is advisable therefore to have the centrifugal sludge pumps installed to operate with flooded suction.

In some plants the process of sludge digestion is accelerated by circulation or agitation of sludge and for this purpose special circulating pumps are available. A pump of this type consists of a cast iron shell bolted to a sludge riser pipe, inside of which there is a non-clogging screw impeller operated by a vertical electric motor mounted above the pump. The unit is so arranged that all joints are sealed to prevent gas from escaping. The discharge from the pump is in the form of a sheet flowing radially and with vigorous action. The circulation is from the bottom to the top of liquid level. The flow may be reversed by reversing the direction of rotation for the purpose of mixing and digesting the surface scum.

Improved Method of Soil Study

by William W. Niven, Jr.
Fort Peck, Montana

Improved apparatus for determining particle-size distribution of a soil has potentialities as a precise method

Promising work has been carried out by the writer in combining the Wiegner and the Kelly methods of determining the particle-size distribution of soils. The new method, insofar as it has been investigated, shows promises of several advantages over other methods that are now in use. It is realized however, that to establish its value definitely, it will be necessary to use the method in conjunction with other methods in the routine analysis of many samples. Since the writer is not in a position to do this it is felt that what has been done should be brought to the attention of others who are more favorably situated.

In brief explanation, a method devised by Wiegner for determining the particle-size distribution of soils, involves the use of an apparatus similar to that shown in Fig. 1a. The water column in the side tube acts as a means of measuring the change in hydrostatic pressure brought about within the sedimentation tube by the settling of the soil particles. The use of this apparatus in mechanical soil analysis has been hindered by three factors: (1) in using a vertical water column, changes in water level are not sufficiently sensitive to give the desired accuracy; (2) as the level of the water falls there is an influx of water into the sedimentation tube and consequent eddy currents which interrupt the settling of the soil particles, and (3) the diameter of the sedimentation tube is so small that the walls of the tube interfere with the settling.

As a means of determining the particle size distribution of materials such as paint pigments Kelly employed an apparatus similar to that of Wiegner. In Kelly's apparatus the side tube is set at as small an angle as possible with the horizontal, thus giving comparatively large displacements of the water level for small changes in hydrostatic pressure.

It has been the purpose of the writer's work to combine the Wiegner and Kelly methods into a similar method more adaptable to mechanical soil analysis.

Apparatus and method

The apparatus (Fig. 1b) was constructed from a 1000 mm. Pyrex cylinder and a section of heavy-walled Pyrex tubing having a 1½ mm. bore. A mark was made around the cylinder at a volume of 700 ml. By calculations based on Stokes' Law it was found that all particles of soil coarser than 0.074 mm. (200 mesh) would settle past a point 20.4 cm. below the surface of the suspension in just 10 sec. The side tube was therefore welded into the cylinder at this distance below the 700 ml. graduation and then bent as shown in the drawing (Fig. 1b). The sine of angle ϕ was carefully determined and the side tube was then graduated through its diagonal section, each division representing 0.1 mm. vertical displacement. The use of heavy-walled tubing reduced the chance for angle ϕ to change; angle ϕ being small, the desired sensitivity was obtained; the use of small-bore tubing greatly reduced the amount of water that could flow into the cylinder, and the size of the cylinder reduced the effects of the walls on the settling particles.

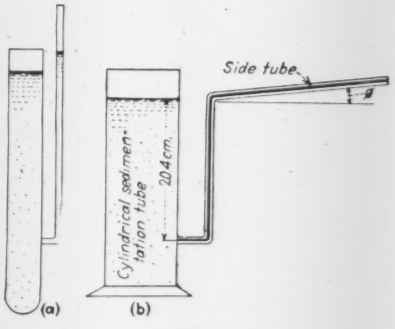


Fig. 1. Simple equipment for determining particle-size distribution in a soil by measuring changes in water pressure as soil particles settle through water.

The apparatus is made ready for a test by filling the cylinder with water to a point just above the junction with the side tube, drawing water up into the side tube, and then emptying the cylinder. Water in the side tube is held to the desired height by a rubber tube and pinch-clamp placed over the open end. The 35-gram sample of soil is weighed into a beaker, thoroughly slaked, and then dispersed by a milk-shake mixer. After dispersing, any coarse sand is permitted to settle to the bottom of the dispersion cup and the suspension is then decanted into the cylinder. The coarse sand is dried and put aside. Adding water to the cylinder brings the suspension volume up to 700-ml. mark and the suspension is then thoroughly mixed by inverting the apparatus several times with the hand held over the mouth of the cylinder. If the side tube is held away from the operator no soil particles will enter it.

As soon as the mixing is completed, the apparatus is set on a level surface, a stop-watch immediately started, and the pinch-clamp on the side tube released. Readings of the water level in the side tube are taken at time intervals of 10 sec.; 1, 3 and 10 min., and 1 and 2 hr. At the end of the test the sediment is washed on a 200-mesh sieve, and any material retained is dried and added to the coarse sand from the dispersion cup. The total weight of material coarser than 200-mesh sieve is thus determined.

Principle of test

The sizes of particles settling in the time intervals used in the test are calculated from Stoke's law. Weights of material settling during these time intervals, from the initial 10 sec. reading on, are then computed from the equation

$$w = \frac{dVSf}{h(S-d)}$$ in which:

w = weight of material settling past the junction with the side tube.
d = density of the suspending medium
V = volume of the suspension above the side tube

S = specific gravity of soil sample
f = vertical fall of water level in side tube
h = height of suspension above side tube

Thus, knowing the vertical change in level of the water column for any time increment, the weight of soil that has settled past the junction during that interval can be calculated from the above equation.

Analyses and checks

Since it is impossible to read the water level for zero time, the weight of material settling in 10 sec. is taken as that weight found to be coarser than 200 mesh. Cumulative percentage of material settling during each successive settling time are then computed from the equation. These values combined with the particle sizes determined from Stokes Law are plotted on semi-logarithmic paper (Fig. 2) to give the size-distribution curve for the sample.

Analyses of two distinctly different types of soil, one high in clay and the other high in sand, using the apparatus of this method were compared with analyses of the same materials by the accepted hydrometer method (Fig. 2). Particle-size distribution curves by these two methods check each other, except in the coarse particle range where variation is caused by differences in determining the per cent of material coarser than 200 mesh other than by any discrepancy in the sedimentation process.

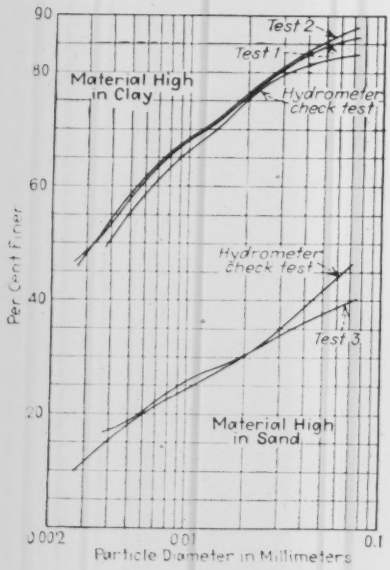


Fig. 2. A limited number of tests using pressure changes to classify clayey and sandy soil samples check results obtained in the usual hydrometer test.

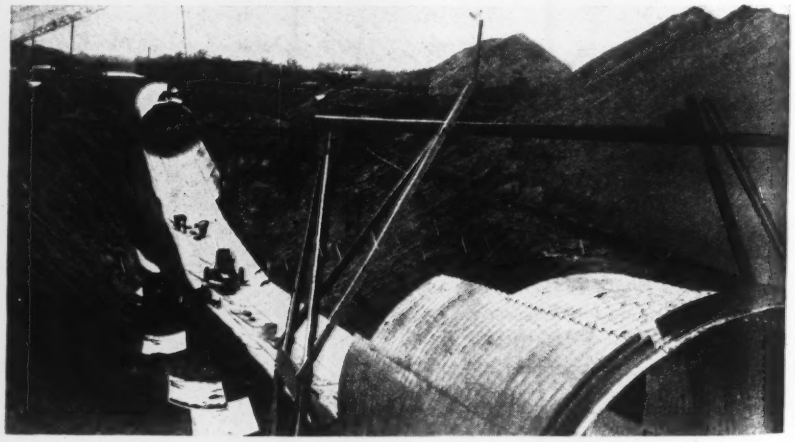
The principal advantage of this method is the reduction of disturbance of the soil particles during sedimentation, a condition that is always questionable in a hydrometer analysis. Other advantages are the ease and precision with which readings can be taken, and the ease of construction as well as standardization. Work with this method has indicated that more extensive use and further investigation may prove it to be a more precise method of analysis than any now accepted as standard.

Corrugated Iron Plate Siphon At Plum Creek, Neb.

by GEO. E. JOHNSON
Central Nebraska Public Power and Irrigation District, Hastings

THE SIPHON shown under construction in the accompanying illustration was designed to carry the 1,500 cu. ft. per sec. flow of the Phelps-Adams irrigation canal under the bed of Plum Creek near Lexington, Neb. The Phelps-Adams canal is a part of the $30,000,000 Central Nebraska (Tri-County) irrigation and power project. While Plum Creek is normally dry, it occasionally discharges a large quantity of storm water. Groundwater at the site is only 5 ft. below the stream bed, and 80 per cent of the excavation was necessarily below this level. The curved corrugated plate design was adopted after very thorough cost studies had been made of various other siphon designs, and the contractor elected to pump the site dry with a well-point system and to erect the siphon at its final grade. The steel conduit is made of corrugated hot-dipped galvanized pure iron plate. The inside diameter is 13 ft. 9 in., and the overall length 290 ft. All joints were bolted for erection purposes and then completely welded inside and out with ¼-in. fillet welds. After welding, the entire surface, inside and out, was painted with three coats of asphaltic paint, which left a coating of approximately $\frac{1}{16}$ in. After inspection and approval of the structure, it was completely strutted inside and excavation backfilled in such a manner that no deformation of the pipe could take place.

In determining the diameter of the pipe, full account was taken of the friction effect of the corrugations. This required only a slight increase in the diameter. The effect of such corrugations is obviously less for a large pipe than for a small one. There were 12,000 lin.ft. of ¼-in. welds in this 290-ft. siphon and the cost amounted to about 29 c. per lin.ft. of weld.



Phelps-Adams canal siphon under Plum Creek shown under construction.

THE WEEK'S EVENTS

Continued from page 491

D. C. License Bill Is Introduced

Senator King of Utah on March 22 introduced a bill requiring professional engineers practicing within the District of Columbia to be licensed. The measure applies to chemical, civil, electrical, mechanical, mining and metallurgical, radio, structural, and other branches of engineering, and licenses will be granted only for the specific fields in which the applicant is qualified.

Before being granted a license as a professional engineer the applicant will be required to certify under oath that he will receive no profit from the practice of his profession except his usual salary or fee; otherwise a modified license will be issued omitting the word "professional."

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Citizens Committee Favors Houston Water Plan

A committee of citizens appointed to study and report on a program for providing additional water supply for the city of Houston, Texas, drawn up by the Chicago firm of Alvord, Burdick & Howson (*ENR*, Sept. 9, 1937, p. 444) has recommended adoption of the plan. Mayor Fonville and other members of the city council have also urged that the program be carried out.

The engineers have proposed two alternative plans by which the city might obtain water from the San Jacinto River. A plan for the complete development of the river at a cost of $10,600,000 would provide a capacity of 100 m.g.d., permitting abandonment of the present well system and providing for the city's water needs, it is estimated, until 1980.

An alternative program, which was the one recommended by the citizens committee, would cost only $7,121,000. This would provide 50 m.g.d. and meet the city's needs until 1950. This project, it is believed, could be self liquidating and, if immediate action is taken, could be in operation by the end of next year.

The less expensive program would involve construction of a dam on the San Jacinto at Sheldon, about 16 mi. northeast of Houston, at a cost of $2,319,000. A pumping plant at the dam would cost $175,000, a canal for carrying the water to the city $266,000, a pumping plant in the city $400,000, a purification plant, also at the edge of the city, $1,014,000. Storage for filtered water would cost $175,000, feeder mains to connect the new supply to the present mains would cost $2,535,000, and a new booster station at the existing Sabine St. plant would cost $237,000.

The present well system has a capacity of 25 m.g.d. The recommended plan calls for gradual elimination of the well system, as the wells dry up and corresponding extension of the San Jacinto River project past the initial stage until the complete development contemplated in the full program is attained.

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Engineer License Law Introduced in Jersey

A new bill for the licensing of professional engineers has been reported out of committee in the New Jersey Assembly. It was introduced into the Assembly March 7 by Assemblyman McClave and was reported out March 21.

The proposed measure would eliminate classified registration in numerous branches, as now provided by New Jersey law, and would establish a uniform registration under the single designation of professional engineer. The bill has the endorsement of the Metropolitan Section of the Am.Soc. C.E.

The New York legislature adjourned March 19 without taking action on any of the numerous bills affecting the professional interests of engineers, either those opposed by the professional societies and the Am.Soc.C.E. or those which were approved.

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Registration Required In Kentucky

A bill for registration of professional engineers in Kentucky has been passed by both Houses of the General Assembly and was signed by the governor March 11. The bill closely followed the model registration law of the National Society of Professional Engineers, will go into effect 90 days from that date.

This brings to 39 the number of states now having engineers registration laws.

Los Angeles Begins Its First Parkway

Groundbreaking ceremonies in Los Angeles March 22 inaugurated work on the long-planned Arroyo Seco Parkway. Although well equipped with many miles of wide boulevards and arterial highways, Los Angeles heretofore has had no parkway-type roads like this, with all grades separated, with opposing traffic divided by a center strip and with local service roads along either side.

Estimated to cost about $2,000,000, of which the U. S. Bureau of Public Roads provides about half, the Arroyo Seco Parkway will extend some nine miles from the present north end of the new Figueroa St. viaduct in the city of Los Angeles to Pasadena. Its two 34-ft. roadways, separated by a 4 ft. dividing strip, follow up the west side of the Arroyo to South Pasadena where the channel will be crossed.

Groundbreaking ceremonies were held on the first contract which includes two grade separation structures just across the Arroyo in South Pasadena. A total of 18 grade separation structures are required. The work is a joint operation of the city, the state highway department and the federal government.

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Connecticut to Qualify Water Operators

The Connecticut Health Department will pass on the qualifications of men operating water treatment plants under the terms of a new sanitary code announced by the Connecticut Public Health Council. The code requires that operators be physically fit to perform manual labor and be able to read instructions and keep records. Where chlorine is used, the operator must be qualified by training and experience to operate chlorinating mechanisms and must be able to take chlorine residual and similar tests.

Operators in filtration plants where chemicals are used must know how to operate filtration equipment, make repairs, supervise the washing of sand, and be able to recognize and correct faulty operating conditions.

A second Connecticut health regulation requires that the location of outdoor swimming pools constructed by building a dam in a stream of water be approved by the local health officer. The regulation makes a distinction between swimming pools with a controlled water supply and bathing places with an uncontrolled water supply such as a brook.

OBITUARY

GORHAM H. HARTER, for 25 years maintenance engineer in Broome County for the New York State highway department, who retired a year ago, died March 26 in Herkimer, at the age of 61. Mr. Harter was a director and past president of the New York State Association of Highway Engineers.

COMMDR. EDWIN F. TILLMAN, naval hydrographer for 47 years, who had done basic hydrographic work along the Atlantic Coast from Maine to Florida, in the Mississippi River from New Orleans to Cairo, and in the Yukon River in Alaska, died March 24 in Washington, D. C., at the age of 79. Although technically he had retired from the Navy in 1905, going on the inactive list at that time, he did important hydrographic work for many years afterwards.

ENOCH ALBERS, 58, engineer and highway contractor of Chehalis, Wash., died there March 22. In recent years he had been employed as an engineer on WPA projects.

MARTIN L. DOWLING, former city engineer of Denver, died in Los Angeles, March 20, at the age of 72.

JAMES B. LEAVITT, topographic engineer for the U. S. Geological Survey, died March 18 in Washington, D.C. at the age of 54. Mr. Leavitt joined the U. S. G. S. in 1905, shortly after his graduation from the Missouri School of Mines. Except for war service, he was active in the survey until last October when he retired due to ill health. Mr. Leavitt saw service overseas during the war as an engineer officer in the 29th Regiment and later as topographic officer of the Sixth Army Corps.

CARL E. GRUNSKY II, for 14 years general superintendent of the East Bay Municipal Utilities District, died March 22 in Oakland, Calif. at the age of 53. Mr. Grunsky, son of the late C. E. Grunsky, who was city engineer of San Francisco and president of the American Society of Civil Engineers, graduated from the University of California in 1905 and also studied at Columbia University. After some years' practice in the West and in South America, he joined his father in the American Engineering Corp. in 1913. During the war he served as a captain in the engineer corps and then returned to practice with his father. He became connected with the utilities district in 1924.

Bureau of Reclamation photo

RAIL, ROAD, AND RIVER BRIDGE CANAL

FOUR BRIDGES cross the All-American canal at Araz Junction, Calif., six miles west of Yuma. Two railroads, the Southern Pacific and the Inter-California, and U. S. Highway No. 80 cross the canal, and the Araz Wash overshoot will carry flood waters of the normally dry Araz Wash across the canal, protecting it from damage in the infrequent but severe storms. The overshoot is the third bridge in the foreground, just beyond the curve of the canal.

The 80-mile All-American Canal will carry Colorado River water across the desert to irrigated sections of the Imperial Valley.

VICTOR K. HENDRICKS, consulting engineer, and formerly chief engineer of the St. Louis & San Francisco R.R., died March 19 at Oak Park, Ill. A graduate of Rose Polytechnic Institute in 1889, Mr. Hendricks spent several years with various railroad and bridge companies and in 1893 joined the Terre Haute & Indianapolis R.R., serving with that company until 1902 as assistant engineer, maintenance of way engineer, and principal assistant engineer successively. He then served for five years with the Baltimore & Ohio as assistant engineer, engineer of maintenance of way, and as division engineer, joining the St. Louis & San Francisco R.R. in 1907 with the rank of assistant engineer of maintenance of way. Under the regime of the U. S. Railroad Administration he was regional engineer for the Southern Region, and subsequently he practiced as a consultant.

THOMAS R. TETLEY, an engineer in the Chicago district for the Federal Power Commission, died March 21 in St. Louis at the age of 58. Mr. Tetley was a graduate of the Columbia School of Mines.

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Deer Creek Contract Let

Contract for construction of Deer Creek Dam and for relocation of railroads and highways in the reservoir area has been approved for award to Rohl-Connolly Co. of Los Angeles on its low bid of $2,189,000. The Deer Creek Dam is part of the Provo River project in Utah.

Although the contract has been approved, actual award will be held up until rights-of-way have been acquired and arrangements made with various local agencies.

The Provo River project is designed to provide supplemental water for irrigated land near Provo and Salt Lake City and to provide domestic supplies for the cities of Provo, Oren and Salt Lake City.

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Safety Net Completed For Vancouver Bridge

Two safety nets to be used in the construction of the first Narrows suspension bridge at Vancouver, B.C., have been compieted by the Royal City plant of the Canada Western Cordage Co. The nets closely resemble those used during the construction of the Golden Gate Bridge at San Francisco. They are made of $\frac{3}{8}$-in. manila with 5-in. square meshes, and the intersections are spliced with rustless metal clamps. The rope has been treated with a fireproofing solution.

Each net measures 56x18 ft. and is bordered with $\frac{1}{4}$-in. galvanized wire rope. They will be put into use as soon as contractors start spinning the

Army Board Disapproves Champlain Seaway

An adverse report on the proposed Champlain seaway connecting the St. Lawrence and Hudson Rivers has been submitted to Congress by the Board of Engineers for Rivers and Harbors. This echoes the adverse recommendation submitted some months ago by the International Joint Commission.

"Data and information now available," Major General Schley, Chief of Engineers, reported, "indicate conclusively that the cost of an adequate deep draft conection between the Hudson River at Albany and the proposed St. Lawrence waterway would exceed the benefits now in prospect. A survey is not recommended. . .

"A waterway . . . should not be seriously considered until or unless commerce on the improved St. Lawrence River develops and reaches such proportions as . . . would justify its cost. . .

"The saving in time estimated at 3½ days per vessel trip is found to reduce the ultimate cost of transportation 50 cents per ton. The total annual savings that the project could develop are therefore estimated at $4,653,000."

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Chicago Suburban Towns Plan Water Works

Berwyn and Cicero, Chicago suburban cities, have retained Charles DeLeuw & Co. to draw up plans for a filtered lake water system to serve some 30 municipalities directly west of Chicago. Only preliminary studies have been made, but Mr. DeLeuw states that the plan contemplates taking water from Lake Michigan off Winnetka and delivering it after filtration to the western suburbs by conduit. The early estimated cost is $7,000,000.

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Changed Highway Setup Proposed on Coast

California will have a state constitutional amendment on its ballot next November proposing establishment of a California highway and traffic safety commission of five full-time members, salaried at $6,000 per year. They would hold office for ten years and be subject to removal only by a two-thirds vote of the Senate. Under the terms of the amendment, members of the commission would be appointed by the governor with advice and consent of the Senate and terms would be so fixed that one new commissioner is appointed every two years. Not more than three of the five commissioners could be members of the same political party.

The present state highway commission would be abolished and all its functions would be taken over by the new organization, which would also have jurisdiction over the highway patrol, the division of drivers' licenses, and traffic law enforcement.

The proposed amendment is said to have the backing of the two automobile associations in California.

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Pensacola Dam Bids To Be Asked in May

The Grand River Dam Authority will have plans and specifications for the Pensacola Dam and its associated generation and water control structures ready for distribution to bidders about May 1. Bids on the project will be received about June 1.

Bids have already been called on several preliminary contracts. Bids for a 4½-mile standard-guage construction railroad and a concrete and steel rail and highway bridge across the Grand River will be received April 11. The engineer's estimate of cost on this contract is $165,000. About April 19 the authority plans to receive bids for construction of a 14-mile transmission line to furnish power for construction work on the main dam.

The Pensacola Dam, on the Grand River in northeastern Oklahoma, will store water for flood control and hydroelectric power development. It is being built by the Grand River Dam Authority, a public corporation of the state of Oklahoma, and is financed by a $20,000,000 loan and grant from PWA.

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Engineering Institute Appoints Secretary

Leslie Austin Wright has been named general secretary of the Engineering Institute of Canada to succeed R. J. Durley who retires April 1 on account of ill health. Mr. Durley, who has been secretary of the institute for the past 14 years, has been named secretary emeritus. De Gaspe Beaubien has been named treasurer of the institue to fill the vacancy left by the death of L. A. Duchastel.

Mr. Wright is a native of Toronto, where he was born in 1888, and is a graduate mechanical engineer from the University of Toronto. For the past eleven years Mr. Wright has been with Kent-McClain Ltd. on structural alteration work. Previous to that time he was chiefly on bridge and grade separation work, including four years on C.P.R. grade separations at Toronto and four years in the bridge department of the city engineer's office at Toronto.

BRIEF NEWS

A BOARD OF AWARDS has been appointed by the executive committee of the American Welding Society to have charge of selecting the recipient of the Lincoln gold medal for 1938. The medal will be given to the author of the paper presented before the American Welding Society which is judged the greatest original contribution to the advancement and use of welding. The board is to be composed of H. L. Whittemore, chairman, G. T. Horton, and A. G. Ohler.

THE MIDWEST POWER CONFERENCE being held in Chicago April 13-15 under the sponsorship of the Armour Institute of Technology, will include a number of papers on dam design in connection with a session on hydropower. Papers will be presented by E. W. Lane, associate director in charge of the hydraulic laboratory of the Iowa Institute of Hydraulic Research, and A. E. Karpov, designing engineer for the Aluminum Co. of America.

DAMAGES of $4,000 against the Connecticut highway department were awarded March 8 to D. H. Clement by a Connecticut superior court. Mr. Clement was injured in a motorcycle accident Feb. 11, 1936, caused by a defect in the pavement of Hot Meadow Road at Simsbury, where the Bloomsfield Construction Co. was installing drains. The court held that the cause of the accident was neglect on the part of the highway commission to repair the road.

AMENDMENT of the New York State building laws as applied to the city of Buffalo will be sought by a committee of public officials and contractors appointed by Mayor Holling of that city. Building laws in Buffalo are stated to be obsolete and more rigid than necessary, resulting in building costs 18 to 20 per cent higher than in other cities of the state.

THE BUREAU OF RECLAMATION is advising all of its engineers on temporary status on projects financed by emergency relief funds to take the regular civil service examinations for their grades; this suggestion was first made six months or more ago and has been repeated several times. As projects change from an emergency relief to a regular appropriation basis, workers are required to get civil service standing. This can be done by qualifying exams at the time of transfer, but it is much simpler if the engineer has already been certified by the Civil Service Commission as eligible for employment.

CALENDAR OF MEETINGS

NATIONAL SOCIETIES

AMERICAN SOCIETY OF CIVIL ENGINEERS, Spring meeting, Jacksonville, Fla., April 20-23.

AMERICAN SHORE & BEACH PRESERVATION ASSOCIATION, annual meeting, Washington, D. C., April 19, and Jacksonville, Fla., April 21.

AMERICAN WATER WORKS ASSOCIATION, annual convention, Roosevelt Hotel, New Orleans, April 24-28.

REGIONAL AND LOCAL

MICHIGAN ENGINEERING SOCIETY, annual meeting, Grand Rapids, April 7-9.

CALIFORNIA SEWAGE WORKS ASSOCIATION, annual spring conference, U. S. Grant Hotel, San Diego, April 11.

GREATER NEW YORK SAFETY COUNCIL, annual convention, Hotel Astor, New York City, April 19-21.

AMERICAN WELDING SOCIETY, Pittsburgh section, and ENGINEERS SOCIETY OF WESTERN PENNSYLVANIA, tri-state welding conference, William Penn Hotel, Pittsburgh, April 29.

AMERICAN SOCIETY OF CIVIL ENGINEERS, Texas Section, spring meeting, Texas State Hotel, Houston, April 29-30.

MARYLAND-DELAWARE WATER AND SEWERAGE ASSOCIATION, annual conference, Emerson Hotel, Baltimore, May 19-20.

SECTION MEETINGS, American Water Works Association:
Illinois, Decatur, April 5-6.
Indiana, West Lafayette, April 7-8.
Pacific Northwest, Spokane, May 19-21.

ELECTIONS AND ACTIVITIES

THE IOWA ENGINEERING SOCIETY elected the following officers at its annual meeting: President, A. A. Baustian; vice-presidents, H. O. Croft and O. W. Crowley; directors, J. H. Ames, L. W. Mahone and Mark Morris. Honors for meritorious papers were awarded to E. S. Joehnk and A. H. Wieters.

JOSEPH S. HELM was elected president of the Asphalt Institute at the annual meeting of the board of directors recently. Other officers elected were: James A. Blood, T. M. Martin, A. M. Maxwell, vice-presidents; Herbert Spencer, treasurer; and F. V. Widger, secretary. B. L. Boye, retiring president, was made chairman of the executive committee.

THE MARYLAND SOCIETY OF PROFESSIONAL ENGINEERS has been organized, as an affiliate of the National Society of Professional Engineers. President of the new body is Fred W. Gast, chief engineer of the Bureau of Customs. Prof. Russell B. Allen of the University of Maryland was elected secretary-treasurer.

A. B. MANSON, general manager of the Public Utilities Commission of Stratford, Ont., was elected chairman of the Canadian section of the American Water Works Association at its annual meeting last month. Dr. A. E. Berry, Toronto Department of Health, was elected secretary-treasurer. It was decided at the annual meeting to attempt to establish a uniform basis for water rates throughout Canada.

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Short Courses

REGIONAL MUNICIPAL TRAINING SCHOOL for water superintendents and water works operators of New York State Municipalities, sponsored by New York State Conference of Mayors, American Water Works Association, and Rensselaer Polytechnic Institute, Cornell University, New York University. Held April 13-15, New York University, New York City.

UNIVERSITY OF WISCONSIN, short course for sewage works operators, sponsored by the League of Wisconsin Municipalities at Madison, April 19-22.

TEXAS A. & M. COLLEGE, short course in highway engineering, directed by the Department of Civil Engineering of the college, in cooperation with Texas Highway Department, College Station, Tex., April 13-15.

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Grade Crossing Accidents Continue Increase

Deaths arising from accidents at highway-railroad grade crossings continued in 1937 the steady increase which they have been registering since 1932 and reached the highest level since 1930. Fatalities in 1937 were 1,875, as compared with 1,786 in 1936, 1,525 in 1932, the lowest figure in recent years, and 2,568 in 1928, the peak year.

Injuries in grade crossing accidents during 1937 totaled 5,136 compared with 4,930 in 1936. The total number of accidents in 1937 was 4,484, an increase of 207 compared with the preceding year.

In spite of the increase in absolute number of accidents, there has been for the past ten years a gradual decrease in the number of deaths per automobile in operation. Thus in 1928 there was one grade crossing death for each 9,538 automobiles in operation as compared with one for each 15,750 automobiles in 1937.

PERSONAL

AARON I. RAISMAN, who has been connected with the design of New York City subway structures for the past 38 years and engineer in charge of the division of design of the New York City Board of Transportation and its predecessors for the past 20 years, retired on a pension April 1. Mr. Raisman, who is 64 years old, graduated from Columbia University in 1898 with the degree of civil engineer. After two years in the engineering department of the Central R.R. of New Jersey he became a structural draftsman for the original Board of New York Rapid Transit Railroad Commissioners, soon advancing to the position of assistant engineer and designer. He has been successively connected with the Public Service Commission, the Transit Construction Commissioner, the Transit Commission, and the Board of Transportation.

M. B. STARR, for ten years engineer of Plymouth county, Iowa, has announced that he will resign June 1.

H. L. SMITH and E. P. MIZELLE, resident engineer and inspector, respectively, for the Arkansas state highway commission in the bridge building and maintenance division, have been dropped from the staff because of lack of work.

SHELLY H. LEE has been made assistant supervisor in charge of District 10 of the Arkansas state highway department at Paragould.

CHARLES P. WILLIAMS, for the past ten years consulting engineer for the National Irrigation Commission of Mexico, has resigned from that post to become project engineer for the Ambursen Engineering Corp. of New York City. He will have entire charge of the field work on the Possum Kingdom dam and power house on the Brazos River in Texas. Mr. Williams was formerly a principal assistant engineer for the Bureau of Reclamation.

ALAND A. C. KARMS has been appointed chief architect of the Connecticut Public Works Department.

E. H. SCHNEIDER, formerly designing engineer on the Moffat water tunnel project for the board of water commissioners of the city and county of Denver, has opened an office in Denver to practice consulting engineering.

LEE H. HUNTLEY has resigned from the electrical division of PWA in Chattanooga to become construction engineer for the Ambursen Engineering Corp. on the Possum Kingdom dam.

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